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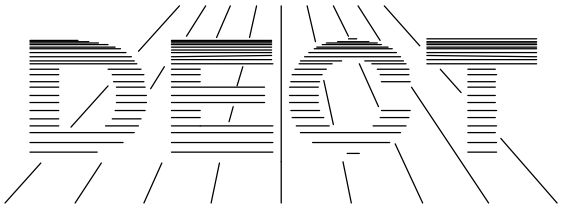

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Foreword

ETSI Technical Reports (ETRs) are informative documents resulting from ETSI studies which are not appropriate for European Telecommunication Standard (ETS) or Interim - European Telecommunication Standard (I-ETS) status.

An ETR may be used to publish material which is either of an informative nature, relating to the use or application of ETSs or I-ETSs, or which is immature and not yet suitable for formal adoption as an ETS or I-ETS.

This ETR has been produced by the Technical Committee RES, Radio Equipment and Systems, Sub-Technical Committee 3 (in charge of DECT) of the European Telecommunications Standards Institute (ETSI).

The present document aims to provide an overall description of the DECT system and concept, DECT standing for Digital European Cordless Telecommunications.

DECT : Digital European Cordless Telecommunications;

ETSI : European Telecommunications Standards Institute;

RES3 : ETSI Radio Equipment and Systems, Sub-Technical Committee 3, (in charge of DECT);

CEPT : Conférence Européenne des Postes et Télécommunications.

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1 Introduction

At the present time there are a number of incompatible cordless telephone systems within Europe. These systems fulfil only a proportion of the requirements and opportunities for personal communication expectations.

The presence of the current systems has itself encouraged an extension of the concept and expectations for cordless communication. Market research has established a clear demand for cordless capabilities beyond those currently offered.

The greatest opportunity for European telecommunications organisations lies in offering a single standard enhanced cordless system for Europe. The size of the European market and the capacity of the European manufacturing base indicates that the fulfillment of the European need will create a spring-board for opportunities outside Europe.

Only a common standard defined by industry, PTTs, and Administrations under the auspices of the European Telecommunications Standards Institute (ETSI) can open up the European market to its full potential.

1.1 The current situation

The extent to which the market is divided can be seen from a review of current products :

- Illegally imported Cordless Telephones;

- National specifications, working generally in one country (UK, France), using low frequencies under 50 MHz;

- CEPT analogue products (CT 1) working around 900 MHz, adopted only by some countries;

- A digital (FDMA) system, developed in the UK, offering the telepoint function as a feature. CT2/CAI;

- A digital (TDMA) system, developed in Sweden and emphasizing business cordless telephony. CT3.

A common European standard will remove the restriction and enhance market opportunities.

This common European standard will be DECT.

1.2 What is DECT ?

1.2.1 Basic characteristics

The DECT concept is one of versatility of application at a cost that encourages wide availability and market adoption.

The concept includes a definition of personal portable communications that requires small, easy to use terminals.

DECT will provide personal communication services at home, in the office and in the street.

The quality of communications is similar to that of a standard telephone.

DECT offers low-power cordless access between portables and infrastructure, at ranges up to several hundred meters. It is utilising dynamic channel selection from approximately 120 available channels.

1.2.2 DECT Systems

- A DECT residential system that interconnects to a PSTN with the features and responses of a standard wired telephone;

- A DECT Business Cordless Telecommunications systems (BCT) that combines the features of a PBX with the mobility of cordless telecommunications for both voice and non-voice applications;

- A DECT telepoint facility that offers public network access to a handset through a public, or privately owned, base station;

- A DECT access system that provides a radio means of extending public and private networks into customer/user premises.

1.2.3 Benefits of DECT

- Versatile application based on a common technology provides an economy of scale that will yield low cost and encourage a wide take-up.

- DECT will allow full cordless application in an average office environment (typically in one hundred times the density of a mobile radio system);

- The user has the opportunity to select from a number of communication options, to suit his particular requirements;

- The manufacturer has the option to provide competitively targeted product according to his own market perceptions;

- The network provider (public and private) has the opportunity to introduce new services and provide alternative means of network access;

- National communication authorities have the opportunity to encourage competitive service provision in new areas;

- DECT allows the use of private "on site" user applications.

2 Services definition

2.1 Introduction

In this section the service and facility requirements of envisaged cordless-telecommunication applications are considered. The approach adopted is to identify application areas, define basic service principles, determine functional capability requirements, and quantify performance parameters. Approaching the problem of definition from a user-group point of view avoids the difficult task of identifying and defining particular applications, especially applications associated with so called large business systems.

2.2 Areas of application: user group

- Residential - private use in houses and apartment blocks;

- Public Access - telepoint, phonepoint access to a PSTN;

- Small (business) CT systems - typically key systems;

- Large (business) CT systems - multi-cell PBX-based building mobile system with roaming and handover;

- Integrated services premises networks, small and large (business) applications - voice and data telephony and LAN access;

- Evolutionary applications - radio access to local public and other networks.

2.3 Service principles

- The technical system specification makes provision for both voice and non-voice transmission;

- The DECT timescale coincides with the introduction of ISDN services. The implementation of all ISDN basic rate services will be possible within the DECT specification;

- To provide the facilities and quality of service to key markets DECT minimises its use of bandwidth to that required by the service carried at any time;

- The DECT specification does not inherently pre-allocate spectrum by application and should seek to offer an integrated communication structure embracing all applications;

- The cost of implementing basic voice only operation must not be significantly penalised by the non-voice provisions in the specification;

- The potential total market for DECT is large with the consequent requirement for low-cost, small-size, high volume products, used in high-capacity applications;

- The technical system specification makes provision for interoperability of a handset unit between user groups. Interoperability is not mandatory;

  NOTE: The intention is not to preclude interoperability or hamper single user group applications.

- The user perception of the combination of quality and value of communication of DECT apparatus must be at least equal to that offered by existing wired telephone services noting there are two parties to communication.

2.4 Capability and features

Capability and features are aligned according to area of application (market segment) rather than product type. It is recognised that widely differing products could serve the same market segment, or a combination of market segments.

The technical system specification makes provision for both basic capabilities and enhancement features.

Some capabilities and features are common to the four prime areas of application (residential, public, small system and large system) and for convenience are listed as follows.

Basic capability

- Function as an equivalent replacement for a wired telephone connected directly to indirectly (e.g. via PABX) to a PSTN;

- Signalling capacity to support standard telephony features;

- Dialling and calling security;

- Emergency services.

Enhancement features

- Interface with ISDN;

- Non-voice transmission, with ability to communicate up to maximum available transmission capacity;

- Air-interface voice, and non-voice, privacy;

- Hands-free operation;

- Handsets serving a combination of market segments or services.

2.4.1 Residential use

2.4.1.1 Basic capability

- Base-station ringer.

2.4.1.2 Enhancement features

- 2 PSTN lines;
- 2 to 4 handsets;
- Intercom via the base station;
- Call transfer between handsets.

2.4.2 Public use

2.4.2.1 Basic capability

- Out-going calls only;
- Secure authentication of handset and user for billing;
- User indication of service availability on handset;
- Multiple independent network operation;
- Tandem use with other mobile systems, appropriate to car, train, plane and ship.

2.4.2.2 Features depending on infrastructure enhancements

- In-coming call (local log-on);
- In-call hand-over to adjacent telepoint base-station;
- Outgoing calls queuing capability for access to radio interface.

2.4.3 Small (business) system use

2.4.3.1 Basic capability

- Single cell;
- 20 extensions or less;
- Handset inaccessible indication at base unit;
- Secure authentication of handset.

2.4.3.2 Features depending on infrastructure enhancements

- Secure validation of handset user;
- Independent small (business) systems can be interconnected (by wire) to achieve coverage expansion without handover;

- Handsets can enrol on other units;

- Message (acknowledged paging) service.

2.4.4 Large (business) system use

No realistic judgement could be made between basic and enhancement features. It is considered essential the specified system should support the following.

2.4.4.1 Capability

- Multi-cell operation;

- Roaming (to find a person for incoming and outgoing calls within the nominated communication area);

- Handover during call;

- Normal (wired) PBX functions must be supported;

- Bearer services (to be expanded);

- Teleservices (e.g. teletext and fax);

- Handset or terminal enrolment;

- Support for systems of highly variable user densities;

- Terminals mounted in a vehicle (e.g. warehouse vehicles).

2.4.5 Non-voice services for DECT

The development of DECT will coincide with the establishment of ISDN networks and the widespread use of integrated services voice/data networks in the office. It is therefore essential that DECT can support an adequate range of non-voice services, to prevent it becoming obsolete before its introduction.

2.4.5.1 Applications

The applications of DECT data terminals fall into two categories:

- Primarily static, using DECT as a cordless drop-line bearer to a high-speed back-bone. Application areas and requirements are related to those anticipated for general network terminal usage;

- Primarily portable, for entirely new applications made possible by the DECT network link such as:

    - portable multi-media (e.g. voice and fax) mail terminal;

    - note-pad with large network-based memory;

    - portable access to personal and corporate data bases;

    - ultra-light, small network-slaved PC emulator;

    - cordless ISD videophone.

2.4.5.2 Teleservices

From a service and facilities perspective, applications such as these examples require the support of a group of general teleservices. These are:

- remote terminal service;
- batch file transfer;
- real-time file access;
- generic ISDN connection-based services.

Applications such as videophone can be successfully mapped on to the last category. To support the other teleservices, DECT must have, as a minimum requirement, appropriate bearer capabilities over which external processes can offer the teleservices. The integration of the teleservice processes in DECT depends upon the implementer. Remote terminal protocols such as X and OSI VT, batch file services such as FT AM and real-time access for X.400 protocols P3 and P7 will be examples to be supported.

2.4.5.3 Bearer services

In order to use the spectrum efficiently, DECT must offer bearers which are well matched to the needs of the teleservices. A (2B + D) so bearer (net 144 kb/s connection-based full duplex) are necessary to meet the needs of the generic ISDN connection-based services, but it is neither efficient nor adequate for the other teleservices. The requirements of the other teleservices are summarised in the table below:

Application	Link Establishment Time	Transaction Duration at Full Rate	Full Rate
Remote Term			
- text	50 ms	100 ms - 5 secs	10 - 20 kb/s
- graphics	50 ms	500 ms - 10 secs	24 - 128 kb/s
Batch File Transfer			
- light	1 - 5 secs	1 - 30 secs	32 kb/s
- heavy	1 - 30 secs	5 - 1000 secs	64 kb/s
Real-time file access			
- slices	50 ms	200 ms - 2 secs	64 - 256 kb/s
- chunks	500 ms	1 - 10 secs	64 - 256 kb/s

2.4.5.4 Spectrum efficiency

Provided the link establishment time requirements are met, the long-term channel usages of these are typically of the order of 0.01 - 0.1 erlangs. These will be translated into spectrum occupancy of 1 erlang, however, if the radio channel access technique cannot meet the link establishment time requirements and thus continuously open channels are required.

2.4.5.5 Error ratios

A characteristic of non-voice services is the high-quality logical channel they require. Net bit-error ratios of 10_{-8} are the minimum acceptable. These may of course be accomplished by use of FEC and ARQ at layers 1-4, but carry an overhead in the physical layer.

2.4.5.6 Asymmetry

Since non-voice services often involve a flow of information which is predominantly in one direction, unidirectional or asymmetric bearers can offer more efficient performance. Greatest efficiency can be achieved if the bearer dynamically adjusts its forward/return ratio to the data requirements. Should this be impractical, a mode with 10 : 1 forward/return ratio is required.

2.4.5.7 System requirements

The need to use spectrum efficiently and at the same time offer an acceptable standard of non-voice performance, therefore impose certain fundamental requirements on the system. These are listed in order of importance:

- a radio resource assignment system capable of allocating different amounts of bandwidth to a channel of the time the channel is established;

- a radio resource assignment system capable of allocating bandwidth between up and down link independently.

Other issues, such as error correction, can be dealt with either at layers 1, 2, or 3 within DECT, or layer 4 of the teleservices function, and thus need further detailed consideration.

2.4.6 Evolutionary applications

2.4.6.1 DECT extension to cellular radio

Clear need is seen for DECT extensions to cellular radio systems to meet the requirements of:

- telepoint in a mobile environment, for example trains;

- to provide portable cordless access to mobile communications (including the GSM) particular in areas where hand portable cellular transceivers are inadequately served.

2.4.6.2 Radio extension of the local public network

This application envisages the use of DECT as the access medium from the distribution point to the customer premises, within the normal DECT coverage capabilities.

2.4.6.3 Distributed DECT head-ends

The DECT system is the basis for a range of business and telepoint-like services. It is expected that the combination of cheaper digital transmission (fibre) and a larger private switches will lead to situations where the radio part of the DECT will be distributed but the base-band processes, channel control and signalling will be centralised. DECT with a 7 to 10 year life-span must accommodate such developments. Investigation of the necessary range has indicated the following:

- In the USA the distance between a private central switch (centrex) and customer building is generally cable-quality limited (copper cables) to typically 12,000 feet (3,8 km);

- Currently equivalent UK plans envisage using local exchanges as the central location, which indicates a services range up to 5 km.

- A telepoint system with the remote transmitters and receivers would require also a 5 km range;

- For application of DECT in a suburban local-network cordless-access mode, range from a residence to an appropriate network concentration point would be 5 - 7 km.

It would seem therefore that DECT should accommodate a transmission range between the DECT control centre and radio head-end of 5 km.

2.5 Grade of service

In terms of user acceptability of such proposals it is essential that cordless connections should closely match wire-connected terminals from a grade-of-service (GOS) point of view. In this report GOS is equated to the overall probability of a call not being set-up or, worse still, being curtailed during a call, in the busy hour.

Assuming that all parts that contribute to a call set-up GOS are small, then the overall value is the sum of its parts. These parts for a cordless system are considered to be.

- That for a PABX alone, typically in the range 0.1% to 0.01%;

  NOTE: in the absence of cordlessness this, plus the element for the PSTN, is what the terminal user perceives.

- That due to congestion in the radio beared channels;

- That due to loss of radio communication caused by poor radio signal coverage of the nominated communication area or cell.

2.5.1 Large (business) system use

It is proposed that the sum of the above parts for call set-up (for on-site part) anywhere in the defined communication area in a cordless business communication system shall not exceed 1%. This value is believed to be acceptable to a business environment in exchange for mobility or freedom from telecommunication wiring restraint.

To a user call curtailment is far more unacceptable than failure to establish a call. It is recommended that the probability of curtailment shall not exceed 0.1% but 0.01% is preferable.

2.5.2 Residential and small (business) system use

It is recommended that the above objectives should apply for residential and small system use. However, in practice such factors as base station siting, density of uncoordinated users, propagation conditions will have a critical effect and are difficult to control. Nevertheless, it is recommended these objectives be used when designing equipment and characterizing performance for residential and single-line business use. This is particularly important when the cordless equipment is designed to be used as the primary means of communication.

2.5.3 Public use (telepoint)

Expectation of the telepoint service is that GOS criteria should be the same as that for large system use within the nominated coverage area. However, commercial factors, independent of the DECT specification, may well limit performance during peak traffic periods.

2.5.4 Non-voice services

Informatic services will be characterized by both the capacity to access suitable channels and access them within an acceptable time. GOS in this context implies the probability of failure; at the present time it is recommended that this value should be 1% in common with voice bearer services.

2.6 Performance requirements

In practice telecommunication traffic density in an interference limited radio system should be considered in a three-dimensional way. The dimensional assumptions made in this report are, however subject to change.

2.6.1 Residential busy-hour traffic density

i) Suburban (detached houses): wide area traffic density = 150E/km^2

ii) Urban (department block): wide area traffic density = 200E/km^2

Busy-hour traffic density within interference range of any handset is equivalent to 1000 E/km^2 ground projection.

iii) Urban (apartment block)

NOTE: Cordless terminal penetration assumed 30%

Busy-hour traffic per terminal assumed 0.05 erlangs.

Growth and convenience of cordless telephony is expected to raise terminal activity from present levels.

2.6.2 Business cordless telecommunication systems busy-hour traffic density

(i) Ground Projected Area mean

Building Density	low (suburban)	design	High (city centre)
Number of floors	3	6	20
Ground area occupied	0.2	0.5	0.6
Area per cordless terminal	40 m^2	20 m^2	20m^2
Erlang/km^2	3000	30000	120000

This table serves to indicate net spectrum activity for inter-building interference purposes. Range of any handset is equivalent to 40.000 E/km^2 ground projection.

(ii) Localized peak

Busy-hour traffic density within interference range of any handset is equivalent to 40,000 E/Km^2 ground projection.

NOTE: Cordless terminal penetration assumed 100%, the total office concept.

Busy-hour traffic per terminal assumed 0.2 erlangs.

2.6.3 Telepoint

According to present estimates the following statistics have been proposed. These may be revised in the light of growth in public mobile radio usage.

Rush-hour traffic density in a London railway station has been calculated to be 900 erlangs/km^2. Similar calculations for airport terminals indicated 5500 erlangs/km^2 (London Heathrow, a single terminal) 1800 erlangs/km^2 (Madrid, Barajas) and 322 erlangs/km^2 (Frankfurt/Main).

It is envisaged that there will be many licensed public telepoint service providers within Europe (we assume more than one per country). Consequently to offer an effective service DECT telepoint will have the capability to support a roaming service between independent service providers. This will require the capability for multiple, concurrent, handset registration.

2.7 Authentication and security

Any public service, e.g. telepoint which requires a charge to be made is vulnerable to attack for the purpose of fraudulent use. DECT will, therefore, have a secure authentication and validation process appropriate to a pocketable handset or other terminal equipment, and forming part of DECT common air interface specification. The process adopted supports:

- removable identification modules and built-in authentication algorithms;

- roaming between telepoint service providers and therefore has the capability to support multiple registrations.

General consideration of the need for authentication has led to the conclusion that these facilities are also important for cordless business communications systems to guard against call interception and

eavesdropping. As a result the provision of a secure authentication process between cordless part and cordless fixed part is MANDATORY, whether the process is built-in at manufacture or a detachable authentication module (semi-removable module, or a form of "smart" card). This is achieved by the provision of a standard (common) authentication algorithm and provision for a private authentication algorithm as indicated in the following table.

	STANDARD ALGORITHM	PRIVATE ALGORITHM
AUTHENTICATION PROCESS	MANDATORY	OPTIONAL
PROVISION		
(i) Built-in to the cordless portable part	MANDATORY	OPTIONAL
(ii) Detachable authentication module	OPTIONAL	OPTIONAL
USAGE		
(i) By Telepoint service providers own customers	OPTIONAL	OPTIONAL
(ii) For authentication of roaming [1] Telepoint portable part	ACCEPTANCE	OPTIONAL

Table 1

A mechanism for by-passing the authentication procedure for the purpose of accessing the emergency services must be provided.

DECT will also have the capability to cipher the traffic signal thereby providing a degree of "privacy" to communication.

3 Radio aspects

3.1 Principles of DECT radio usage

3.1.1 Introduction

This part presents the basic concepts of the Digital European Cordless Telecommunication systems (DECT) radio usage. The concepts presented here are applicable for cordless extensions to all circuit-switched networks, such as ISDN, analogue PSTN, or PABX. However main attention is given to ISDN-applications and public cordless services, e.g. telepoints.

In defining DECT, the following key objectives were considered:

- the structure should allow any reasonable application;

- the structure should allow any reasonable implementation; and

- the structure should allow the cordless extension to be an ISDN-terminal.

Many of the concepts presented in this Document are similar to those applied in the Pan-European digital mobile radio system (GSM). On the other hand, the unpredictable traffic and propagation conditions in a mostly private environment require sometimes different approaches to be taken.

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1) Roaming is defined (in this context) as the ability of a cordless terminal equipment to receive or initiate calls on independent telepoint networks

3.1.2 Differences to standard ISDN

There are three aspects of radio communication which result in major differences to wired ISDN: resource management, mobility management, and error management.

Resource management

In radio communications the transmission medium is shared among the users and needs careful management. Conversely, a wired ISDN subscriber has assigned the physical transmission medium (his/her subscriber loop) all the time. The radio resource management needs result in specific layer 1 and 2 procedures not known in wired ISDN.

Mobility management

The fact that a cordless user is mobile and roaming is very similar to the case where a wired ISDN user would be allowed to unplug his unit and to reconnect it at an arbitrary place in the network, this even during a call. To cover these cases, reliable link management procedures are needed in the lower layer protocols of systems offering handover. In addition, public systems need an authentication procedure in the network layer protocols.

Error management

The unreliable radio channel requires error control mechanisms which are not present in the wired ISDN layer 2 protocol.

3.1.3 Scope

The system design remains still in an evolutionary stage. Below is presented a consistent layered structure capable of supporting 32 kbit/s circuit-mode services. DECT will consist of several compatible structures which remain to be developed to provide different service modes.

3.2 The layered structure on the radio link

3.2.1 Overview

A structure of four layers is used for the signalling protocols as shown in figure 1.

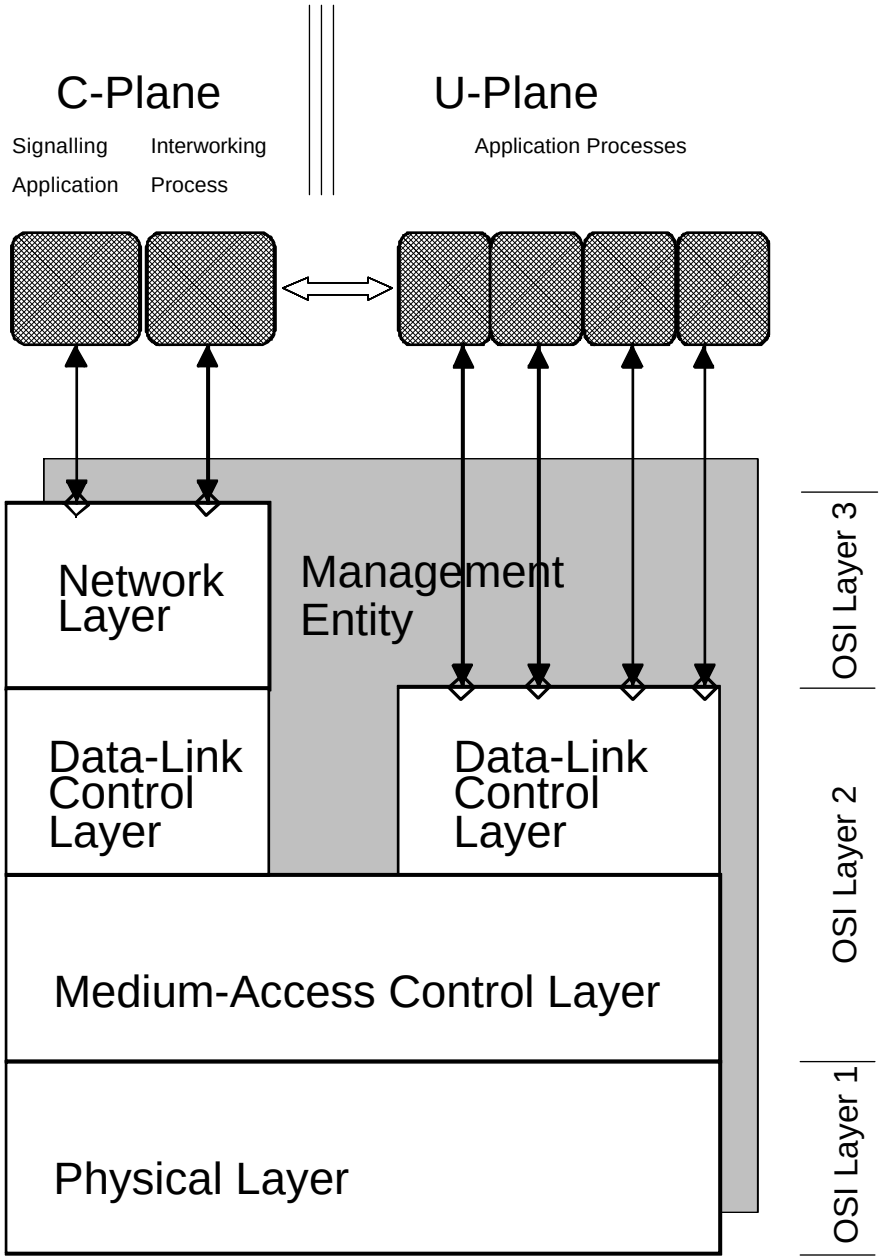

Figure 1: DECT Layer Structure

The traditional OSI layer 1 comprises DECT's physical and parts of the Medium Access Control (MAC) layer. The other part of MAC and the complete Data Link Control (DLC) layer are comparable to the OSI layer 2. DECT's network and OSI layer 3 are identical. The physical layer (PHL) creates a set of bit pipes through the radio medium. As such it is comparable to the road network. In the DECT Cordless Fixed Part (CFP) the physical layer's logical end is usually at the Radio Fixed Part (RFP).[1)]

The MAC layer's task is to choose a suitable physical channel and to pass information reliably through this channel. If the service to be offered to the higher layers requires it, MAC has the possibility to activate multiple physical channels and to offer asymmetric throughput. The logical end of the MAC is again the RFP. The DLC layer provides reliable transport of the data through the radio medium even when cells (or RFPs) are switched during communication (handover). The DLC layer's logical end point is in the Common Control Fixed Part (CCFP).

The NetWork Layer (NWL) is responsible for the transport of data between network nodes. As such it provides the data routes within the DECT network as well as to the outside world. The logical end here again is in the CCFP. Transport of the information to the end user would be the task of the Transport Layer.

The DLC and Network Layers are described in Clause 4, Networks structure.

The functions of the layers and the according primitives between them by definition involve always peer-to-peer communication. There are, however, a wide variety of functions which involve only one peer and typically require decisions to be made (e.g. the decision to initiate a hand-over). Furthermore, some of these management functions require information from more than one layer. Therefore the management functions are contained in a management entity (MGE) which interfaces to all layers.

3.2.2 Physical Layer (PHL)

The physical layer's tasks are as follows:

[1] Modulate and demodulate radio carriers with a bit stream of a defined rate to create a RF channel;

[2] Create physical channels with fixed throughput;

[3] Observe the radio environment to (i) activate physical channels on request of MAC, to (ii) recognise calling physical channels (i.e. attempts from one end point to establish a physical channel), to (iii) acquire and maintain synchronisation between transmitters and receivers, and to (iv) notify the management entity about the status (field strength, quality, etc.) of physical channels.

Some details concerning the physical layers are given in figure 2

RF channels

RF channels are radio carriers allocated to the DECT service modulated with a bit stream of 1152 kbit/s. The modulation is Gaussian Frequency Shift Keying (GFSK) with a relative bandwidth BT = 0.5. The spacing between RF channels is 1.728 MHz. The same RF channel is used in both directions fixed side (RFP) to portable side (CPP), as well as CPP to RFP.

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1) The Radio Fixed Part (RFP) is the entity of functions of the fixed infrastructure which is associated to one cell. Each cell has one RFP. An RFP is somewhat different from a base station as a base station usually is understood to be the hardware module present at the cell site. Some functions of the RFP, however, although present for each cell individually, may be implemented at some central location.

Physical channels

Physical channels are created on the RF channels using a Multi Carrier Time Division Multiple Access/Time Division Duplex (MC-TDMA/TDD) scheme.

A structure suitable to offer twelve duplex channels with a bearer rate of 38.8 kbit/s is shown in figure 2.

The frame length is 10 ms.

The average transmitted power per physical channel is 10 mW or 10 dBm.

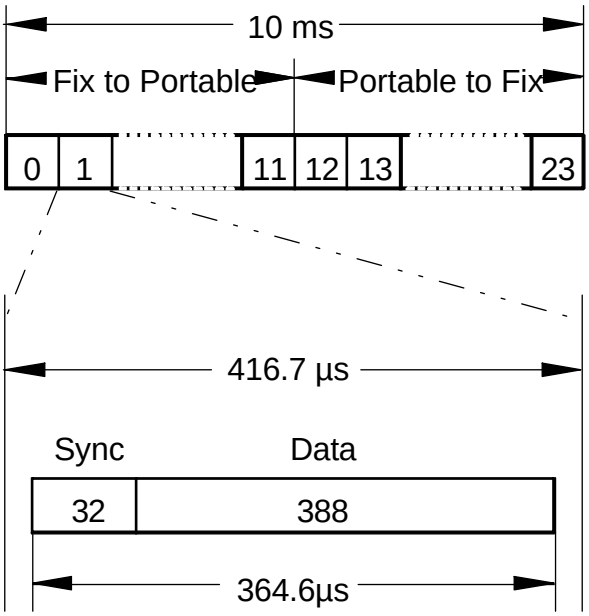

Figure 2: DECT Physical Layer PHL

The 24 time slots, twelve for each direction, have a length of 416.7 ms. They are used for the transmissions of bursts. Bursts have a length of 420 bits corresponding to 364.6 ms. The sequence of one burst every 10 ms constitutes one physical channel. Obviously, its throughput is 420 bit/10 ms or 42.0 kbit/s.

The burst is 52.1 ms shorter than the slot. This guard space allows for small timing errors, propagation dispersion, etc.

3.2.3 Medium Access Control layer (MAC)

As explained earlier the MAC layer's prime task is to allocate radio resources. It does so by dynamically activate and deactivate the physical channels and by optimum consideration of both the needs of the associated signalling channel (C-channel) as well of the user information channel (I-channel). An additional channel offered to the upper layers is the paging channel (P-channel) via which portable stations may be called from the network. Finally, a broadcast channel (Q-channel) provides the portable repeatedly with information in order to recognise the network and its capabilities, hence allowing an efficient access to the network.

Three classes of functions reside within the MAC:

1) Creation, maintenance, and release of bearers by activating and deactivating physical channels. These functions will take into account changes of bearer capacity needs during the connection, as well as the need to change physical resources (within an RFP) during a connection due to unacceptable quality, i.e. intra-cell handover;

2) Multiplex the four logical channels (C, I, P, and Q) onto the physical channels;

3) Segment the data frames or the data stream received from the upper layer to transport them using the data packets provided by the physical layer. If required data segments may by transmitted using more than one physical channel;

4) Protecting the data. Signalling data is tested for transmission errors with a cyclic redundancy check and retransmitted if necessary. User data may not be protected at all (e.g. in the case of speech transmission) or be protected according to the quality requirements of the service. It is noted that while the classical layer tasked with error control is the OSI data link layer, DECT assigns this function to the MAC. The reason is that transmission errors are most efficiently treated on the basis of individual radio links. In the DECT model these exist only up to the MAC layer.

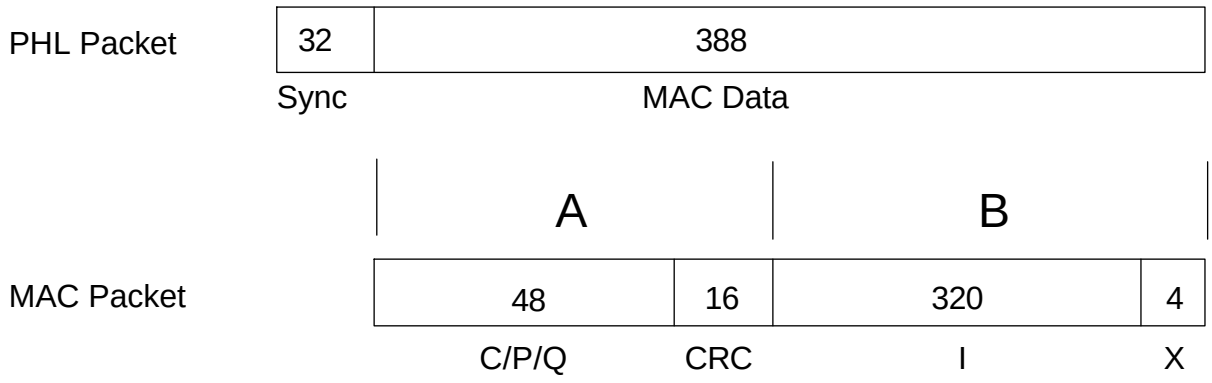

Figure 3: DECT Medium Access Control, MAC

Figure 3 shows the multiplex scheme as it would be used, e.g. for normal telephony during conversation.

Field A bearing the associated signalling channel (C) and the broadcast (Q) and paging (P). 48 bits are transmitted each burst. C, P, and Q share therefore a throughput of 4.8 kbit/s. Capacity is allocated upon demand while a minimum capacity for each channel is guaranteed. The remaining 16 bits of the A field are used to protect the data with a CRC check.

The B field is used to transport user information (I-channel). It offers 320 bits per burst or 32 kbit/s. The 4 X bits are determined from some of the 320 bits from the I-channel. They are however not intended to protect the I-channel from transmission errors but to detect partial interference with the burst independently from the user service. Such a detection is of prime importance to allow unsynchronised systems to operate in the same geographical area.

It is noted that other multiplex schemes exist, in particular during the call set-up phase.

3.2.6 Management Entity (MGE)

The management entity is responsible for taking decisions which involve only one side of the communication. Typically the following functions and decisions are performed in the management entity:

1) Radio resource management, which includes the choice of free channels or the assessment of the quality of received signals.

2) Mobility management, which includes attachment (or change of attachment) to cells in idle mode, or the registration of portables into networks or location areas of this network.

3) Error handling, which includes the termination of a call in case of interruption of the radio link.

It is noted that the management entity has neither a peer entity nor an interface to the outside world. As such neither its procedures nor its primitives exchanged with the layers are subject to a standardisation. However, the DECT standard will include some rules or performance requirements for the MGE.

Radio resource management

It is noted that in DECT radio resource allocation and management involves MGE at the PHL and MAC layers, while in GSM the Management Entity and the Network Layer are responsible. The reason is that DECT uses a decentralised dynamic channel selection (DCS) procedure, whereas GSM's approach is a network directed fixed channel allocation (FCA). DECT's procedures together with some comparison are given in subclause 3.3.

3.3 Capacity management in DECT

3.3.1 Introduction

This section presents some of the procedure which DECT employs for managing the available capacity. Bearing in mind the unpredictable offered traffic, the unpredictable radio propagation environment and the unknown interferences from adjacent systems, DECT must provide the following features:

- DECT must support uncoordinated system installations co-existing on a common frequency resource (1880 - 1900 MHz) for all systems;
  This feature avoids splitting the common frequency resource between different services or users, and is in itself a capacity gain;

- DECT must provide an easily engineered and economic installation of closer and closer cells, whereby the efficiency of the Dynamic Channel Selection procedures (DCS) and the high speech quality needs to be maintained;
  Small cells is the main key to high capacity. However, the real limit on how small the cells can be made, depends on how well the following factors are maintained when the cells become smaller: - Easily planned (engineered) - Economic (base stations cost including installation) - Effective DCS - Maintenance High Speech Quality (no interruptions);
  The key features of DECT are designed to allow high capacity, while maintaining high speech quality, by meeting the above mentioned requirements. Especially important is the unique DECT quick seamless (no interruption) decentralised inter-cell or intra-cell handover, which elegantly copes with changing conditions, without need for central control.

3.3.2 The concept of the basic DECT base station

The basic DECT base station consists of one single radio transceiver that can change frequency from time slot to time slot.

This simple, but powerful base station, can thus on each time frame operate on all 12 duplex time slots, each slot operating independently on any of the 10 DECT carriers. With a complexity comparable to that of a DECT handset, has a capacity corresponding to 12 radios and a combiner in traditional analogue land mobile radio systems. It offers 5 E average traffic with a grade of service less than 0.5 %, corresponding to 25 hand sets with 0,2 E each in a PBX, or one base station per 1000 m^2 in a 5000 E/km^2 telepoint service.

While operating on different carriers, each call connected to the same base station always uses a different time slot.

3.3.3 The Dynamic Channel Selection (DCS).

DECT utilises a simple but efficient and robust dynamic channel selection procedure. DECT physical channels are allocated decentralised between each portable and its closest base station. For each call the portable chooses a channel that for the time being is best for the wanted local connection.

A consequence of the DCS procedure, there is no need to plan in detail how many channels are needed per base station. This maintains a high grade of service even with local density variations.

3.3.4 Call set-up using base station beacon channels.

Each base station is always active on at least one channel, and that every active channel broadcasts system information and base station identification. This allows any portable, by receiving only, to identify any system or base station within reach.

When a handset by listening has recognised a wanted system, the receiver locks to it, by locking on any active channel on the strongest (nearest) base station. In this idle locked state the handset listens every 160 ms for a possible paging call from the system.

When the handset wants to contact the system, either because it wants to originate a call or because it has been requested so by a paging call from the network, the DCS procedure looks for a free physical channel and accesses the system by sending an appropriate burst. By setting up calls (or handing them over) to the closest (strongest) base station, this concept provides stable DCS, high capacity and high link quality.

3.3.5 Handover

In order to accommodate very small cells, the need arises for quick and seamless handover requiring neither central control nor complicated procedures.

The key to seamless handover is TDMA in combination with the decentralised dynamic channel selection the old link is maintained on one slot in the portable, while the new link is set up in parallel on another time slot. When the new link is established, the (new) base station requests the central to make a seamless switch from the old to the new radio link.

The handover is portable controlled: while it communicates on the original link it scans the other channels and records free channels and identities of base stations that are stronger than the actual one, and is thus prepared to perform a very quick handover.

Handover is made as soon as another base station is stronger than the one of the current connection. Thus in a well engineered system is always performed before the quality goes down.

The nature of DCS is that a channel in use can (occasionally) be stolen, and therefore the quick DECT seamless inter-cell and intra-cell handover increases the capacity and cuts call curtailments drastically. DECT does not depend at all on the old channel to quickly set up the new.

3.4 Radio resource

3.4.1 Spectrum requirements

The spectrum requirement for DECT is determined as a function of the offered traffic density. The assessment is based on the calculation of the re-use volume, i.e. the volume which allows the use of one particular channel only once. The re-use volume multiplied with the traffic density yields the traffic per re-use volume. Standard traffic formulae deliver the number or channels which the system has to offer to handle the traffic. Depending on the carrier spacing and the number of timeslot channels per carrier we immediately find the necessary bandwidth.

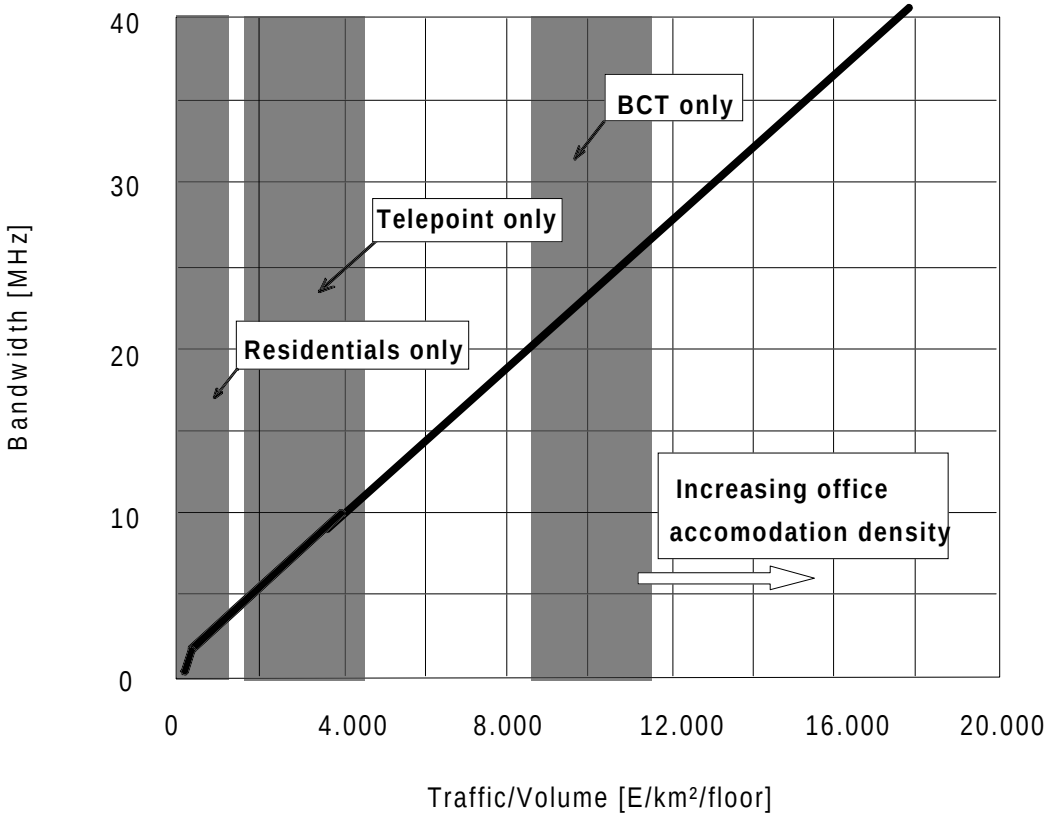

Figure 4: DECT Spectrum Requirements Telephony

Figure 4 shows the bandwidth requirement as a function of the traffic density. The frequency requirement for various DECT applications can then be assessed. To accommodate 10000 E/km^2/floor, which is assumed to be the maximum telephone traffic in an office building, the requirements can be calculated to 22.5 MHz (10 carriers or 120 channels) at a grade-of-service (GOS) of 1%. With this GOS the resulting spectrum efficiency is 444 E/MHz/km^2. The actual traffic figures depend on the operator's offered grade-of-service.

Two independent simulations performed in Sweden and the United Kingdom (adapted to the parameters used in this contribution) report spectrum efficiencies in the order of 500 E/MHz/km^2/floor for 32 kbit/s transmission i.e. a very good confirmation of the model used here.

3.4.2 The allocated frequency band

The allocation of frequencies is done under the responsibility of CEPT. The band 1880 to 1900 MHz has been designated to the DECT service.

3.4.3 Evolution of spectrum usage

Future low bit rate speech codecs will bring options to accommodate even more traffic with the given spectrum allocation; it is, however, noted that the spectrum needs assessed in subclause 3.4.1. do not take into account the requirements of evolutionary services such as high bit rate data transmission.

4 Networks structure - network aspects of DECT

4.1 Introduction

This section presents the concepts underlying the system and network architecture of DECT, and the impact these have on the higher layer protocols.

DECT has been standardised at a time when very many new telecommunications networks are under development. Like ISDN, the key objective has been to ensure the maximum applicability of the standard in a variety of applications based on these new networks. This has removed the freedom to mould the air-interface standard to a symbiotic fixed network environment, as was the case in, for example, the Pan-European digital cellular system GSM.

Instead, the DECT design must explicitly enable users to access a dis-homogeneous range of networks and in particular:

- Analogue PSTNs, PABXs and Key Systems;

- Digital and ISDN public networks, PABXs and Key Systems;

- GSM networks, permitting DECT connections both to the mobile terminal and to fixed network access points such as the A-interface;

- Telepoint networks, both existing and evolving;

- LANs such as IEEE 802 series, with the DECT network offering bridging and routing functions with acceptable performance;

- CCITT Recommendation X.25 networks.

The next section will show how such a broad and varied range of networks can be served by a single, simple DECT air interface.

4.2 Architectural aspects

A DECT system may be connected to two types of network:

- a local network, typically local in extent, offering telecommunications services which are rich in features or performance; examples might be PABXs or high-speed LANs;

- a global network, typically national or international in extent, offering limited services and rigidly imposing the constraints of such networks; examples include the PSTN and the PSPDN.

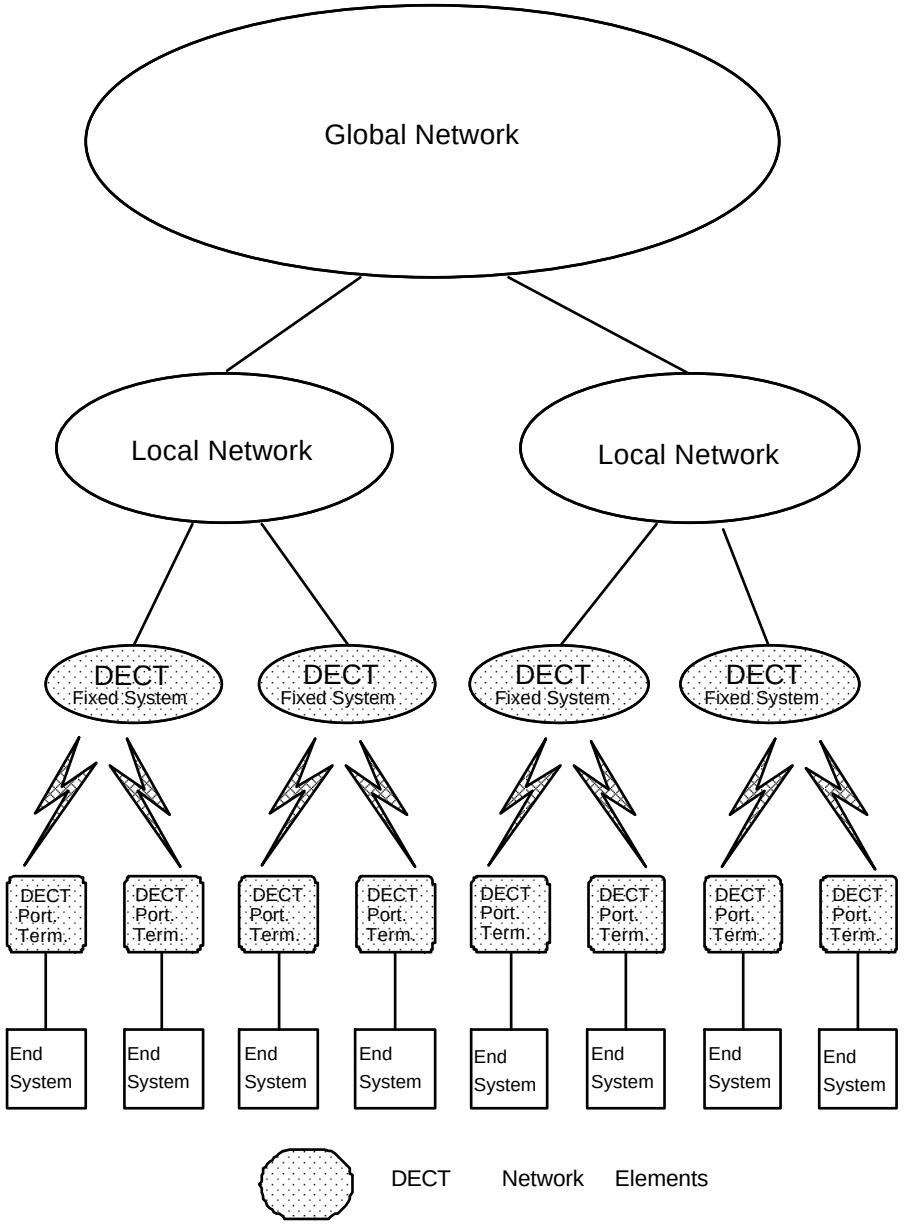

Figure 5: DECT Reference Model

A DECT system itself consists conceptually of three units:

- Coverage microcells, numbering from 1 to perhaps 100, contiguous, overlapping, irregular, providing dependable cordless coverage to all users; associated with each cell is a set of functions necessary to control and manage that one cell, sometimes known as the Radio Fixed Part (RFP).

- A Central System, tasked with the protocol and management functions necessary to sustain all the DECT connections in the system. Since DECT users can move between cells, all higher level protocols and call related functions, mobility management, authentication and privacy, bandwidth and resource management must reside in a conceptually central system;

- Interworking unit(s), which convert protocols, formats and codings from those used in the DECT network to those used by the network to which the system is attached - ISDN, PSTN, GSM etc.

The key to the flexibility of DECT lies in this dependence on interworking units. The handset, which is always critical in terms of cost, bulk and weight, is screened from the complexity and diversity of the networks beyond DECT by the Inter-Working Units (IWU), which carry the burden of translation.

In the implementation of a cordless PABX for example, the PABX call switching functions are part of the local network which lies on the external side of the IWU. The standard admits absolutely no air-interface distinction between a call from a portable to a fixed telephone and a call from one portable to another portable.

It must be emphasised that these important architectural concepts do not directly limit the way manufacturers choose to implement systems: very many will choose to tightly integrate the local network, the interworking unit and the central system together to create a cordless PABX. Nevertheless, the clarity of the architecture has important benefits in the definition of the various protocols.

4.3 Control and user elements

Data flows in DECT are divided into control and user streams.

Control data is used exclusively (1) to control the functioning of the DECT network, and may be compared to the ISDN or GSM D-channels, without the user data flows permitted in these latter systems. Typical functions carried out in the C-plane are:

- requests for and confirmations of service on the DECT network;[1)]

- exchange of DECT mobility and security information;

- creation, definition and control of the appropriate inter-working function.

Due to the similarity between many DECT control functions and those of external networks, most signalling from these networks is mapped by the inter-working function into the control plane and carried as DECT-specific messages. Examples would be call set-up, called-number transmission ("dialling") etc. This is however not necessarily the case, and some external network signalling, such as some LAN control and timer-critical ISDN signalling may be carried in the user plane.

User data is carried in the user plane. This is a stream that flows between the inter-working units in the portable and the fixed part. In most cases, data is converted by the IWUs for carriage in the U-plane. Speech signals, for example, are coded into CCITT Recommendation G.721 for transport in the U-plane. The central system typically has U-plane functionality, for roles such as handover route switching and error-protection, but these functions are strictly controlled by messages in the C-plane. The relationship between control and user plane are shown in figure 6.

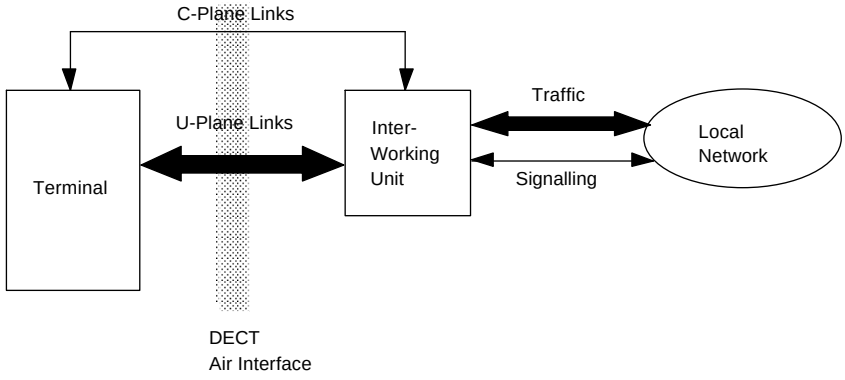

Figure 6: C- and U-Plane Relationship

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1) subject to possible special connectionless user

As a result of these functional requirements, the protocols for the C- and U-planes differ. The C-plane has a full protocol stack defined up to and including the OSI network layer (layer 3). The U-plane only includes data-link protocols, and these are null for many services.

The bandwidths associated with the C- and U-planes are widely variable. For simple speech circuits, the C-plane will access 24 kb/s during call set-up and 2 kb/s during a call, whilst the U-plane will access 32 kb/s during a call.

For more sophisticated connections, such as data calls, the C-plane may use 24kb/s during a call and the U-plane may access up to 320kb/s.

4.4 Protocol features

The air-interface protocols of DECT are structured according to the OSI layered approach, following the usage adopted for local-area networks. The structure is shown in figure 7 below

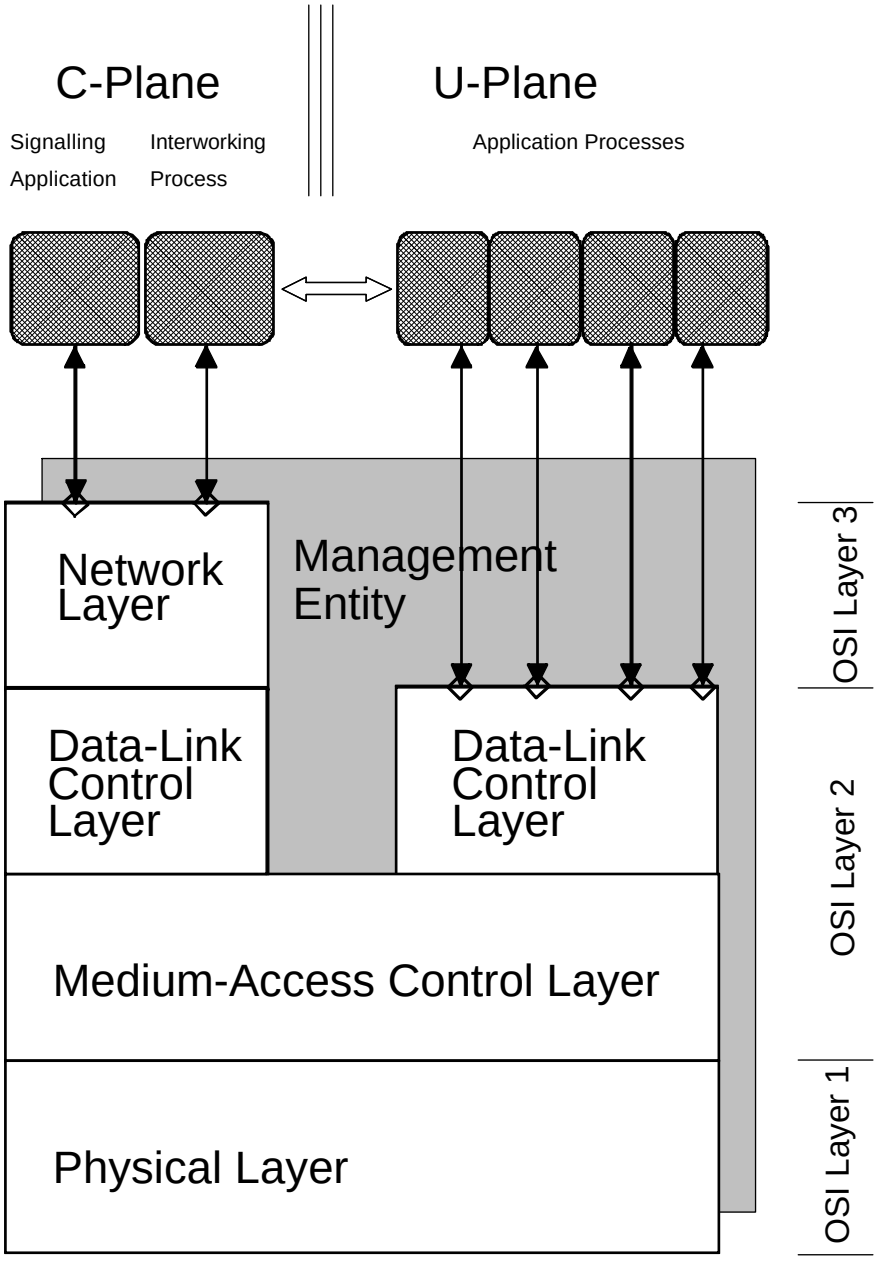


Figure 7: DECT Layer Structure

The physical and medium access protocols are dealt with in the chapter on radio aspects. In this section, the Data-Link Control (DLC) and network protocols will be reviewed. Their internal structure is shown in figure 8 below.

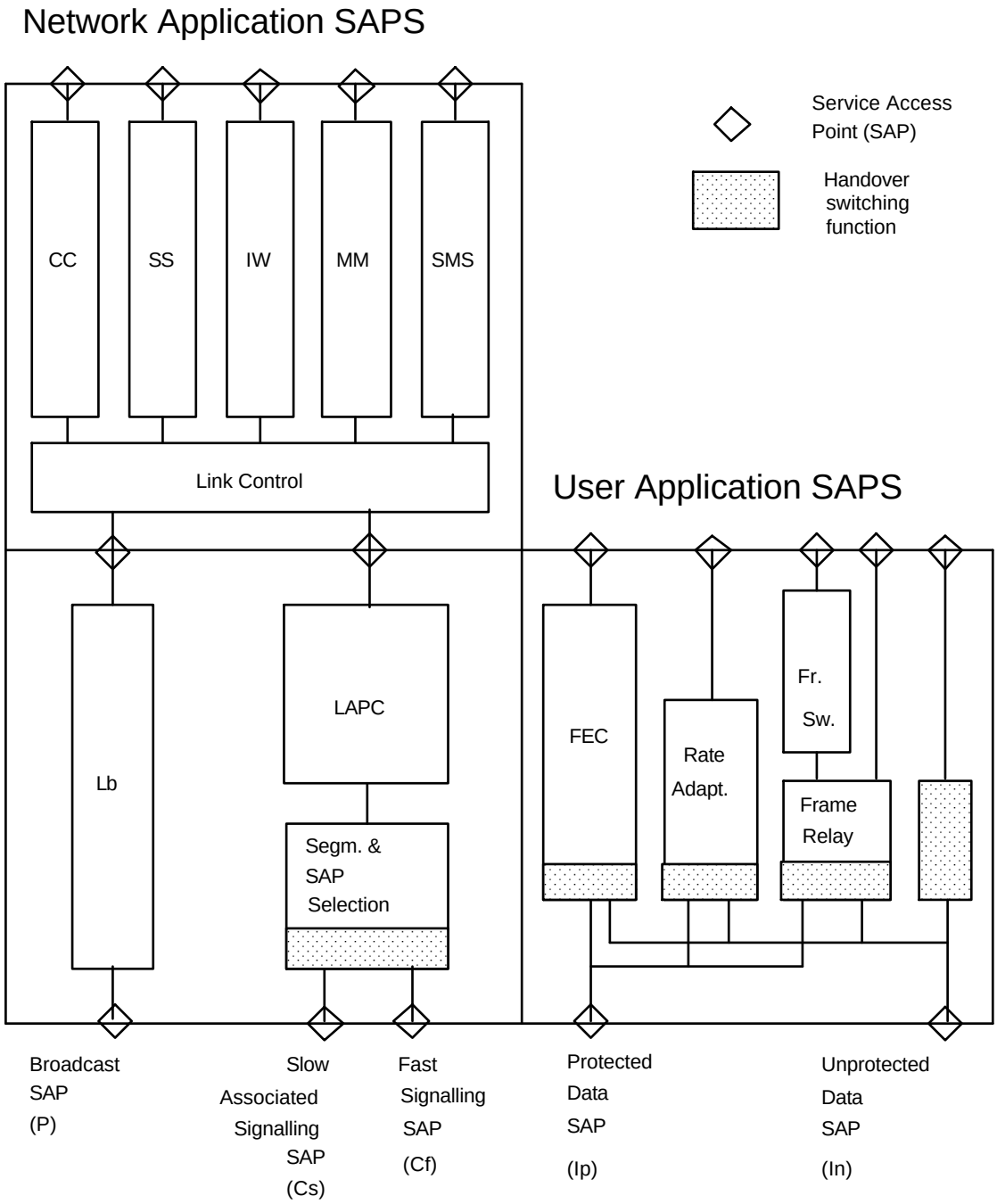


Figure 8: Overview of Protocols

Data Link and Network Layer

4.4.1 The data link protocol

The role of the data link protocol is to create and maintain reliable connections between the portable and the central system. Over these connections, in the C-plane, Network layer messages can dependably be sent.

The C-plane contains two DLC protocols. One, called Lb, offers a connectionless broadcast service, and is very simple indeed. This is used principally for paging portables to support incoming call alerting. The other protocol is used for in-call signalling and is known as Lc+LAPC, abbreviated here to LAPC. This is derived from the CCITT Recommendation Q.921 on ISDN for LAPD, and draws extensively upon GSM Recommendation 04.06. A number of features of LAPC deserve mention:

- Only point to point services are supported. Point to multipoint services use Lb;

- Due the fact that portables can spontaneously appear, disappear and move, and the fact that mobility is supported both at MAC level and at layer 3, TEIs have been replaced by simpler per-call Logical Link Numbers;

- Variable length frames are used, based on length indicators, permitting local optimisation of frame overheads against retransmission and handover delays;

- Long network packets can be carried by several DLC packets if required, reducing handover and retransmission delays;

The characteristics of LAPC are closely matched to those of the underlying MAC service. Segment sizes are chosen so that frame boundaries always align to inherent MAC timing boundaries, which provides excellent security against loss of synchronisation.

The U-plane services are defined and selected according to application. At the time of writing, six possible DLC services are under standardisation: these are:

- null service, offering un-modified MAC bearers;

- frame relay for simple packet transport;

- frame switching, for time-critical packet transport,

- fully error corrected, with FEC, for delay and error sensitive applications such as ISDN videophone;

- rate adapted, for modem and serial-line substitution;

- escape, for proprietary and future expansions to the standard.

These standardised U-plane services are intended as tools with which manufacturers and service-providers can tailor an offer; the simple domestic handset, by contrast, will typically not incorporate such value-added features.

4.4.2 Network layer protocol

The capabilities of the DECT system are greatly determined by the characteristics of the network layer protocol. Much of the software complexity lies here, but much of the power and flexibility too.

Many ideas and techniques have been drawn from the ISDN protocol contained in CCITT Recommendation Q.931 and the GSM Recommendation 04.08, but the protocol is substantially new. At the time of writing, the protocol is still under intensive development.

The role of the network layer is to provide the means to request, justify, allocate, manage and abandon key resources in the central system and portable. The resources are those necessary to maintain a cordless call between them and to connect the DECT system to an external network.

The protocol is structured as a group of connected entities as already shown in figure 8. These are:

- Call Control (CC);
- Call-independent Supplementary Services (SS);
- Interworking Unit (IW);
- Mobility Management (MM);
- [Short Message Service (SMS)];
- Link Control (LC).

Call Control

This key entity has the following capabilities:

- Establishment and release of network connections;
- Negotiation of connection capabilities;
- Instancing and control of inter-working units;
- Transfer of call-related supplementary services.

The underlying principle is, as always, to keep the DECT system as open as possible by ensuring maximum compatibility between terminals and fixed systems. So a phase of negotiation is an integral part of call set-up, in which terminal and network seek to offer the user the highest common denominator of performance.

However, with the objective of keeping the complexity within limits, not all functions are exhaustively and rigidly specified - particularly those relating to supplementary services. The definition of a common vocabulary for requesting these services has been deemed adequate to meet most needs.

Call-independent supplementary services

This part of the protocol supports in an open, DECT-standard way a suite of services that users of advanced telecommunications services now take for granted; these include features such as call forwarding, and follow-me. In addition, a suite of functions provide effective charge-management performance, such as advice of charge, receipting and reverse charging. This module is still under study.

Mobility management

Mobility management is a most important element in DECT performance. It is the appropriate design of this relatively simple module that permits DECT to be interfaced so readily with networks such as GSM, telepoint and advanced cordless PABXs.

Four major functions are implemented: Identity management, authentication, location administration and subscription procedures.

Identity management serves to maintain and exploit the powerful structure of identities implemented in DECT. Each terminal and network can have different, context- and location-dependent identities, and nicknames are extensively used to save spectrum. Network layer procedures serve to allocate and activate these identities as appropriate.

Authentication is a critical function in DECT. Shortly after the connection is established, the portable is challenged by the base with a random number. The portable must provide a correctly calculated response to prove its authenticity. The calculation is carried out according to a secret algorithm. The portable may also optionally challenge the fixed system.

Location administration allows the portable to tell the network where it is and what state it is in even when there is no call. An extension of the protocol allows the handset to inform a different network node of its location and status during a call. This permits an open access network to cause a high-level call handover between network nodes, greatly expanding the access area for the DECT user.

Link Control

Link control is responsible for matching and coordinating the various logical links provided by the data-link layer to the needs of the network layer entities. The primary example is the coordination of paging and LAPC channels during call set-up.

A particular feature of the link control protocol is its support for virtual calls. The link control entity can decide to suspend or shut down the lower layer connections if there is no traffic, whilst maintaining intact the network connection. Once traffic restarts, the DLC and MAC links are rapidly resumed. This capability is of particular importance in systems with low levels of bursty traffic, such as data into a LAN, and reduces by a large measure the spectrum loading.

4.5 Speech compatibility

The principal factors affecting the quality of speech transmitted by DECT are coding quality and delay.

Speech transmitted over DECT, whether connecting to the PSTN or ISDN, is according to CCITT Recommendation G.721. This reduces the data rate to 32 kb/s, and is sufficiently robust to operate without any error protection.

The DECT MAC processes introduce a round-trip delay of approximately 20 ms. This has been intensively studied, with the following conclusions:

- far-end ("innocent") parties will not experience quality degradation due to echoes providing the terminal is designed to provide adequate acoustic insulation between loudspeaker and microphone. International global network echo-cancellers and suppressors will be protected by the same expedient;

- the DECT user will under some circumstances experience degradation of quality due to unsuppressed delayed echoes from the PSTN. A simple echo-canceller/suppressor in the fixed part is therefore required.

It is considered that the resulting speech quality of DECT should be excellent.

5 Time scale

5.1 Achievements

1989

- Feb. 89 — RES-3 Meeting in Brussels, joint meeting with CEPT-SF and provision of Project-Team mandate;

- Mar. 89 — ETSI-Technical Assembly Meeting in Nice, agreement of RES-3-89 mandate;

- Jul. 89 — ETSI to nominate Project-Team to commence work by 1st September;

- Oct. 89 — RES-3 Meeting in Madrid to review progress, Technical Assembly submissions and complete services and facilities document;

- Oct. 89 — Report from CEPT-RARF on band allocation for DECT.

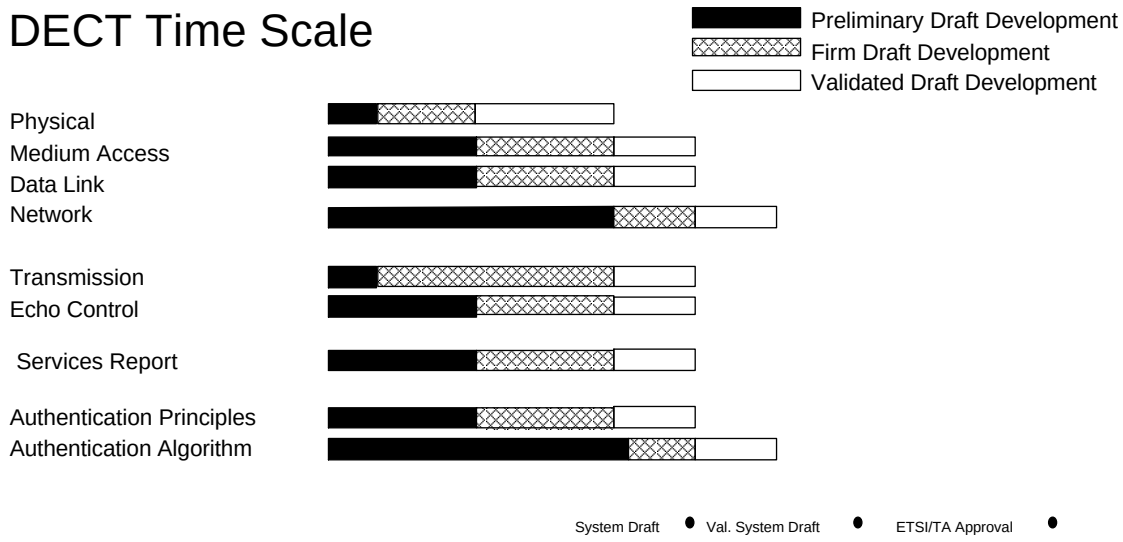
1990

- Jan. 90 RES-3 Meeting in Taormina, Physical Layer as preliminary draft

- May. 90 RES-3 Meeting in Bern, physical layer as firm draft, medium access control layer as preliminary draft, data link control layer as preliminary draft, speech coding and transmission as preliminary draft;

- May. 90 Authentication and security principles.

5.2 Timescale



5.3 List of deliverable documents

Document type	Responsibility for drafting	Responsibility for maintaining	Change Authority	Action
Working assumption	WP	WP	WP	Acceptance by RES-3
Preliminary draft	WP	WP	WP	Acceptance by RES-3
Firm draft	WP	RES-3	RES-3	Approval by RES-3
Validated draft	WP	RES-3	RES-3	Approval by RES-3
System draft	WP	WP	RES-3	Approval by RES-3
Validated system draft	WP	RES-3	RES-3	Approval by RES-3
Public enquiry draft	RES(3)	RES(3)	Experts' group	Public Enquiry
Draft ETS	RES(3)	RES(3)	Experts' group	
ETS	TA	ETSI		Distribution

6 DECT terminology

6.1 Scope

This document has two main sections: Definitions and Glossary.

Definitions provide long definitions of words that are commonly used in DECT documents. This section contains the standard definitions for use in all DECT documents. Not all such terminology finds use in this reference document.

Definitions are in alphabetic order. Alternative titles appear in (brackets) after the main title. The first title should be used whenever possible.

Parentage of title is shown in angled brackets: <parent>.

The assumed consequences are:

<Other standards>:	DECT will not change this definition.
<blank>:	No parent, but unlikely to change (common usage)
<DECT>:	DECT specific term. Subject to change, and also it may not align to other definitions of the same word.

Glossary provides short definitions of abbreviations and acronyms.

Glossary terms are listed in alphabetic order. Words that are defined in Clause 2 appear in "quotes".

6.2 Definitions

Assembly (Reassembly)

The process of combining 1 or more smaller segments into a larger segment of data. The reverse process is "segmentation".

Attach <DECT>

The process whereby a CPP has the possibility of reporting itself as active in a chosen DECT fixed system. The reverse process is detach, which reports the CPP as inactive.

NOTE: An attached portable termination is assumed to be ready to receive calls.

Authentication (of a subscriber) <DECT>

The process whereby a DECT subscriber is positively verified to be a legitimate user of a particular DECT fixed system. Authentication is generally performed at call setup, but may also be done at any other time (e.g. during a call).

Bearer

See "MAC Bearer" or "Bearer service".

Bearer Handover <DECT>

The handover process provided by the MAC layer. It allows one MAC MBC entity to modify its underlying bearers while maintaining the service provided to the DLC layer. Bearer handover is slot based.

Bearer Service <CCITT Recommendation I.112, term 202>

A type of telecommunication service that provides a defined capability for the transmission of signals between user-network interfaces.

NOTE: The user-network interface is assumed to correspond to the top of the DECT Network layer (OSI layer 3).

Broadcast

An unacknowledged "connectionless" mode of transmission, with the additional understanding that the transmission is not addressed and can therefore be received by any other system. In general the transmitter disregards the presence or absence of receivers. See also "Multicast".

C-plane <DECT>

The control plane of the DECT protocol stacks. This plane contains all of the internal DECT protocol control, but may also include some external user information. The C-plane stack always contains protocol entities up to and including the network interworking (sub)layer.

Call (Single Call) (Single-bearer call) <DECT>

The complete process(es) relating to any one Network layer peer-to-peer association, if it can be achieved using only one duplex bearer. Any call that needs different capacity should be labelled "Multi-call".

CCFP (Common Control Fixed Part) <DECT>

The generic term for the one central component (common functional elements) of a DECT fixed system. A CCFP only includes DECT components, and therefore may refer to only part of a physical entity.

Cell <DECT>

The domain associated with a single antenna(e) system. For most purposes, a cell can be considered as the "coverage area" surrounding the antenna(e) system. The definition also includes the case of a distributed antenna (e.g. a leaky feeder). A cell may include more than one source of radiated RF energy (i.e. more than one radio end point and/or more than one RFP), but they must always share the antenna(e) system.

Centrex <prENV 41007-1; Jan 1990>

An implementation of a private telecommunication network exchange that is not located on the premises of the private network operator. It may be co-located with, or physically a part of a public exchange.

CFP (Cordless Fixed Part) <DECT>

The generic term for a DECT fixed system. CFP usually refers the simplest DECT fixed system, where CCFP and RFP are both contained in a single physical entity: this definition of CFP can include non-DECT components. See also "SRFP".

Channel

See "Physical channel".

Cluster <DECT>

A conceptual grouping of cells. A cluster defines the domain over which bearer handover is possible. (Handover to a cell that is not part of the same cluster can only be done by connection handover at the DLC). A cluster can vary in size from a single cell up to a complete DECT fixed system.

Connection

See "MAC connection".

Connection Handover <DECT>

The process provided by the DLC layer. It allows a set of DLC entities (C-plane and U-plane) to reroute data from one connection to a second new connection, while maintaining the service provided to the Network layer. Connection handover is DLC frame based, using a switch function.

Connectionless Mode (C/L)

This refers to the transmission of one self contained unit of data from one source point to one (or more) destination points in a single phase. The transmission is invoked by a single primitive, that contains both routing information (address) and data, and each primitive is serviced completely independently. Connectionless transmissions require the peer-to-peer associations to be prearranged. Connectionless protocols are unacknowledged (the service user can acknowledge by sending an independent connectionless acknowledgement in the reverse direction if needed).

Connection Mode (C/O) (Connection Orientated Mode)

This refers to the use of a three phase transmission mode. Phase 1 is setup, where a (virtual or physical) connection is established between two or more peer entities (and also between each peer and its service provider). These connections require no prior arrangements (unlike C/L mode). Phase 2 is data transfer where the connection is only used to transfer data. The established nature of the connection allows the data to be sequenced and acknowledged. Finally, phase 3 is release where the connection is formally ended.

Coverage Area <DECT>

The area over which reliable communication can be established and maintained. The boundary of this area is defined by the contour where normal call setup is successful 99% of the time in a noise limited environment (assuming no network blocking). The useable area will often be smaller than the coverage area due to interference from other users.

CPP (Cordless Portable Part) <DECT>

The generic term for any DECT terminal. This is a general term that includes both "Cordless Terminal Adaptors" (CTA) and "DECT handsets" (D-hs). CPP always refers to a physical entity (ie the definition includes all real products).

CTA (Cordless Terminal Adaptor) <DECT>

The generic term for a DECT terminal where the "D-pt" elements and the ES elements are not physically integrated. This defines any (portable) terminal, that offers a bearer service and that fully complies with the DECT CI. A CTA does not include any teleservices (applications). CTA refers to a physical entity.

DECT Cordless System (D-c)

The DECT elements that together represent the cordless parts of a DECT network. All parts of a D-c must be individually locked to at least one RFP of the (same) associated D-f. See also "DECT portable termination".

DECT Fixed System (D-f) <DECT>

The collection of elements that represent the fixed parts of a DECT network. A D-f is defined to support handover between all RFPs in the fixed system. A large D-f can contain several RFPs but only one CCFP. (A "CFP" is a DECT Fixed System in one box.)

DECT Network <DECT>

The combination of one or more D-f (DECT fixed systems) and their associated D-pt (DECT portable terminations). A DECT network is defined by its identities: one DECT network has only one network address for each subscriber, and has only one set of access rights (this set may include several UGIs).

NOTE: This definition only contains the D-f and D-pt elements. Therefore it can be related to the common use of "network" by considering an ES to be attached to the DECT (sub)network via a D-pt port.

DECT Portable Termination (D-pt) <DECT>

The DECT elements of any cordless terminal (any CPP). All DECT-portable terminations shall be CI compatible. See also "DECT Handset", "CTA" and "CPP".

DLC Frame <DECT>

The format used to structure all messages that are exchanged between DLC layer entities. In the C-plane, a DLC frame contains four basic fields - address, control, length and information - where each field is an integral number of octets long. Different frames are used in the U-plane.

DECT Handset (D-hs) <DECT>

The generic term for a DECT terminal where the "D-pt" elements and at least one ES element is physically integrated. This defines any (portable) terminal, that offers a teleservice and that fully complies with the DECT CI. DECT handset refers to a physical entity.

DLC Link <DECT>

An association between two DLC layer entities. This can either be one C-plane association or one U-plane association.

NOTE: This is a very specific use of the word link, and it should not be confused with the more general "Telecommunications Link".

Double-simplex bearer (Double-simplex) <DECT>

The use of two "simplex bearers" operating in the same direction on two physical channels. These pairs of channels shall always use the same RF carrier and shall always use evenly spaced slots (i.e. separated by 0,5 TDMA frame). A double-simplex bearer shall only exist as part of a "Multi-call".

Duplex Bearer <DECT>

The use of two "simplex bearers" operating in opposite directions on two physical channels. These pairs of channels shall always use the same RF carrier and shall always use evenly spaced slots (i.e. separated by 0,5 TDMA frame).

ES (End System) (E/S) <ECMA Recommendation TR44>

A system that contains application processes (teleservices). From an OSI point of view, these are considered as sources and sinks of information.

Field

A continuous region of data (ie adjacent bits) that jointly convey information. Typically, a packet will contain several fields. If data is not continuous then it is defined to be two (or more) fields.

Flow Control

The mechanism that is used to regulate the flow of data between two peer entities. Flow control usually operates independently for the two directions of a duplex association.

Frame

See "TDMA Frame" or "DLC Frame".

Full Channel (Full Physical Channel)

Simplex transmissions in one "full-slot" on one "RF carrier" in successive "TDMA frames" by any "radio end point". See also "Physical Channel".

Full Slot <DECT>

The period of time equal to 1/24 of a TDMA frame. This period has space for one "physical packet" and one "guard space".

Generic

Used to mean a generalised set or general purpose set, often in the sense of basic or ordinary.

GFSK (Gaussian Frequency Shift Keying)

This is similar to GMSK except the modulation index is not implicitly defined (i.e. an MSK modulation index of exactly 0,5 is not implied).

Global Network <see DECT reference model>

A long distance telecommunication service capable telecommunication network. Examples are a PSTN, an ISDN, a PLMN, a PSPDN, a CSPDN and GSM.

NOTE: The term does not include legal or regulatory aspects, nor does it indicate if the network is a public or a private network.

Guard Space <DECT>

A period of silence, that is included at the end of every slot, in order to prevent adjacent "physical packet" transmissions from overlapping even when they originate with slightly different timing references (e.g. from different end-points).

Half Channel (Half Physical Channel)

Simplex transmissions in one "half slot" on one "RF carrier" in successive "TDMA frames" by any "radio end point". See also "Physical Channel".

Half Slot <DECT>

The period of time equal to 1/48 of a TDMA frame. This period has space for one "half physical packet" and one "guard space".

Handover <DECT>

The process of switching a call in progress from one physical channel to another physical channel.

NOTE 1: There are two physical forms of handover: intra-cell handover and inter-cell handover.

NOTE 2: The handover process reconnects the call at layers 1 and 2, while maintaining the call at layer 3. This layer 2 reconnection can either be at the DLC layer (see "connection handover") or at the MAC layer (see "bearer handover").

Inter-cell Handover <DECT>

The switching of a call in progress from one cell to another cell.

NOTE: This only defines the form of handover, it does not define a specific process.

Inter-cell Handover <DECT>

The switching of a call in progress from one physical channel of one cell to another physical channel of the same cell.

NOTE: This only defines the form of handover, it does not define a specific process.

Local Network <was "Extended Services Network">

A telecommunication network for local telecommunication services. Examples are a PTN and an IEEE802 LAN.

NOTE: The term does not include legal or regulatory aspects, nor does it indicate if the network is a public network or a private network.

Link

See "DLC link".

Location Registration (Log-on) <DECT>

The process whereby the position of a DECT portable termination is updated in one or more databases. (These databases are not part of a DECT fixed system, but they control the routing of calls). Location registration can be static (e.g. pre-programmed) or dynamic (e.g. via location registration messages).

Logical Channel

A generic term for any distinct data path. Logical channels can be considered to operate between logical end points.

MAC Bearer (Bearer) <DECT>

An association between one source MAC TBC entity and one destination MAC TBC entities. See also "Simplex Bearer", "Duplex bearer" and "Double Simplex Bearer".

MAC Connection <DECT>

An association between one source MAC MBC entity and one destination MAC MBC entity. This defines a set of related MAC services (set of SAPs), and it can involve one or more underlying MAC bearers.

NOTE: This is a very specific use of the word "connection" and it should not be confused with the more general use.

Multi-Call (Multi-bearer call) <DECT>

The generic term for any network layer service that requires more capacity than can be provided by one "Duplex bearer".

Multicast

An unacknowledged "connectionless" mode of transmission, with the additional understanding that the transmission is addressed, and should only be received by members of a closed (user) group. See also "Broadcast".

Multiframe <DECT>

A repeating sequence of 16 TDMA frames. This defines the longest timing interval within DECT, and it is used to multiplex infrequent "broadcasts" (e.g. basic system information or paging). The multiframe timing also allows idling DECT portable terminations to operate at a lower duty cycle by only requiring them to receive part of one slot in each multiframe.

Network (Telecommunication Network) <prENV 41007-1; Jan 1990>

All the means of providing telecommunication services between a number of locations where the services are accessed via equipment attached to the network.

Node <CCITT Recommendation I.112>

A point at which switching occurs.

Paging <DECT>

The process of "broadcasting" a message from a DECT fixed system to one or more DECT portable terminations. Different types of paging message are possible. (For example, the "call request" type of paging message orders the recipient to respond with a call setup attempt).

Phase <DECT>

One discrete part of a procedure, where the start and end of the part can be clearly identified (e.g. by the arrival or dispatch of a primitive).

Physical Channel (Channel) <DECT>

Physical channels are created by transmitting modulated physical packets in one particular "slot" on one particular "RF channel" in successive "TDMA frames". One physical channel provides a connectionless simplex service, and channel use is fully defined by the transmissions. (Physical channels can use either "Full slots" or "Half slots"). See also "simplex bearer".

Physical Packet (Packet) <DECT>

The burst of data that is transmitted in one "slot". (One "slot" contains one physical packet plus one "guard space").

Primitive

A distinct (but abstract) data element that is passed between adjacent protocol layers. Primitives come in four types (-Request) (-Confirm) (-Response) or (-Indicate). A service primitive contains one SDU. (Typically each abstract primitive will be carried in a concrete structure: this structure would contain a concrete header that identifies the primitive type).

Private <prENV 41007-1, Jan 1990>

An attribute indicating that the application of the so qualified term, e.g. a network, a equipment, a service, is offered to or is in the interest of a determined set of users.

NOTE: The term does not include any legal or regulatory aspects, nor does it indicate any aspects of ownership.

Public <prENV 41007-1, Jan 1990>

An attribute indicating that the application of the so qualified term, e.g. a network, a equipment, a service, is offered to or is in the interest of the general public.

NOTE: The term does not include any legal or regulatory aspects, nor does it indicate any aspects of ownership.

Radio channel

No defined meaning. This term should not be used.

Radio End Point <DECT>

The location of the lowest sublayer of the DECT physical layer. (i.e. the transmitter and receiver of radiated RF energy).

Registration <DECT>

An ambiguous term. Use either "location registration" or "subscription registration".

RF Carrier (Carrier)

The centre frequency occupied by one DECT transmission.

RF Channel

The nominal range of frequencies (RF spectrum) allocated to the DECT transmissions of a single "RF carrier". This nominal bandwidth is centered on the RF carrier, and is equal to 1.5 times the bit rate.

RFP (Radio Fixed Part) <DECT>

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. An RFP corresponds to a physical entity, and only includes DECT components. See also "SRFP".

Roaming <DECT>

The process whereby a CPP can initiate and receive calls on more than one DECT fixed system.

NOTE: There are two aspects to roaming: Terminal Mobility which involves the ability of the terminal (the user) to be in continuous motion (or stationary) while accessing and using telecommunication services. Roamer acceptance which is the process of granting a CPP access to any DECT fixed system. This may include network capabilities that keep track of the terminal.

Segment

The generic name for a "field" that only represents a portion of a complete message.

Segmentation

The process of dividing a larger segment of data into 1 or more smaller segments. This is typically required because of size limitations of the service provider. Segmentation can be applied to packet data or continuous data. The reverse process is assembly.

Sequencing (Sequence numbering)

The process of labelling a set of data segments so that the segments can be reassembled in the correct order, regardless of the order they are received. Sequencing can be applied to segments of packet data as well as segments of continuous data (see "Segmentation").

Simplex Bearer <DECT>

A simplex bearer is the MAC layer service that is created using one "physical channel" (see definition of "physical channel"). See also "Duplex bearer" and "Double Simplex Bearer".

Slot <DECT>

Means "Full slot" and "Half slot". The accompanying text applies fully to "Full slots" and "Half slots".

SRFP (Single Radio Fixed Part) <DECT>

This defines the arrangement of a basic RFP, as commonly assumed in DECT system analysis. An SRFP contains only one radio end point, and this is the only radio end point in its cell. A SRFP is defined to support several calls, up to the limits of its single radio end point.

Subscriber (Customer) <DECT>

The natural person or the juristic person who has subscribed to telecommunication services, and is therewith responsible for payment.

Subscriber Group <DECT>

A group of DECT subscribers that have a common structure of subscriber identity (IPSI). See also "User group".

Subscription Registration <DECT>

The infrequent process whereby a DECT subscriber becomes an approved member of a DECT user group. A subscription registration is usually required before a user can make or receive calls as a member of that user group (i.e. before a CPP can access a DECT fixed system(s) of the associated service provider).

Switching <CCITT Recommendation I.112>

The process of interconnecting functional units, transmission channels or telecommunication circuits for as long as required to convey signals.

TDMA Frame (Frame) <DECT>

The period of time containing 24 DECT "full slots. A TDMA frame starts with the first bit period of full slot 0 and ends with the last bit period of full slot 23.

Telecommunication <CCITT Recommendation I.112>

Any transmission and/or emission and/or reception of signals representing signs, writing, images, and sounds or intelligence of any nature by wire, radio, optical or other electromagnetic systems.

Teleservice <CCITT Recommendation I.112>

A type of telecommunication service that provides the complete capability, including terminal equipment functions, for communication between users, according to protocols that are established by agreement.

U-plane <DECT>

The user plane of the DECT protocol stacks. This plane contains most of the end-to-end (external) user information and user control. It does not include any internal DECT protocol control. The U-plane protocol stack can be null at the Network layer and at the DLC layers for some services.

User (of a telecommunication network) <CCITT Recommendation I.112>

A person or machine delegated by a subscriber (by a customer) to use the services and/or facilities of a telecommunication network.

User Group <DECT>

A group of DECT subscribers that have a common set of access rights to DECT fixed systems (i.e. have subscribed to the same service provider). A user group is the smallest such grouping: all members of one user group always have the same access rights (larger grouping is achieved when two different user groups have the same access rights).

6.3 Glossary

ACI: Adjacent Channel Interference. The received power that comes from an adjacent "RF channel".

ACP: Adjacent Channel Power. The transmitted power that spills over into an adjacent "RF channel".

ARQ: Automatic Repeat Request. The process of automatically requesting a retransmission of data that is received in error.

BBC: Broadcast Bearer Control. A MAC layer functional grouping.

BFSI: Broadcast Fixed System and RFP Identity. The identity that is regularly broadcast by an RFP, and also used as an D-f to D-pt handshake.

CEP: Connection End Point. A logical reference point between peers.

CRC: Cyclic Redundancy Check. A cyclically generated "field" of parity bits that give a unique signature for a given "field" of information bits. By convention, CRC parity bits are optimised for error detection, and not error correction.

CSPDN: Circuit Switched Public Data Network.

C/L: Connectionless mode. See definitions.

C/O: Connection (Orientated) mode. See definitions.

DBC: Dummy Bearer Control. A MAC layer functional grouping.

dBc: dB relative to the peak power of an unmodulated carrier.

dBm: dB relative to 1 milliwatt.

DECT: Digital European Cordless Telecommunications.

DLC: Data Link Control. (layer 2b of the DECT protocol stack)

ERP: Effective Radiated Power.

FMID: Fixed part MAC Identity. A MAC layer identity, used for bearer establishment and release.

IFEI: International Fixed Equipment Identity. A unique identity that is embedded into every fixed station (i.e. the international serial number).

IFSI: International Fixed System Identity. A unique identity that defines the fixed system operator (i.e. the access rights).

IPEI: International Portable Equipment Identity. A unique identity that is embedded into every terminal (i.e. the international serial number).

IPSI: International Portable Subscriber Identity. A unique identity that defines the subscriber (typically the home address of the subscriber - where to send the bill).

ISDN: Integrated Services Digital Network.

LBN: Logical Bearer Number.

LCN: Logical Connection Number.

LLN: Logical Link Number.

MAC: Media Access Control. (layer 2a of the DECT protocol stack)

MBC: Multiple Bearer Control. A MAC layer functional grouping.

NWK: Network. (layer 3 of the DECT protocol stack)

PABX: Private Automatic Branch Exchange.

PBX: Private Branch Exchange.

PCI: Protocol Control Information. A collection of "fields" that are used for the peer to peer protocol control. In strict OSI terms these should appear as a header, but in a more general layered model they can be header, tail or both.

PDU: Protocol Data Unit. The data transferred between two peers. A layer-N PDU contains two components: part (or all) of an SDU (from layer N+1) plus the PCI for layer N.

PHL: Physical. (layer 1 of the DECT protocol stack)

PMID: Portable part MAC Identity. A MAC layer identity, used for bearer establishment and release.

POT(S): Plain Ordinary Telephone (Service). The simplest form of the basic analogue telephony teleservice.

PSPDN: Packet Switched Public Data Network.

PSTN: Public Switched Telephone Network.

PTN: Private Telecommunication Network.

RSSI: Radio Signal Strength Indicator. A quantitative measure of the strength of one "RF channel".

SAP: Service Access Point. A logical reference point between layers. One SAP refers to one distinct service type, and it can handle several simultaneous layer N+1 users by giving each user a different "CEP identifier".

SDU: Service Data Unit. An N-layer SDU contains the service (user) data from layer N+1. SDUs are transferred between layers as part of a service primitive. See PDU.

TBC: Traffic Bearer Control. A MAC layer functional grouping.

TDD: Time Division Duplex.

TDMA: Time Division Multiple Access.

TPSI: Temporary Portable Subscriber Identity. A shorthand form of the IPSI.

UGI: User Group Identity.
A fixed system can define three different user groups:
PUGI=Primary UGI: Always broadcast in the BFSI;
SUGI=Secondary UGI: Broadcast in the Q channel;
TUGI=Tertiary UGI: Never broadcast.

6.4 Acknowledgement

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