ETSI EN 300 175-2 V2.9.1 (2022-03)

EUROPEAN STANDARD

Digital Enhanced Cordless Telecommunications (DECT); Common Interface (CI); Part 2: Physical Layer (PHL)

Reference

REN/DECT-00352

Keywords

DECT, IMT-2000, mobility, radio, TDD, TDMA

ETSI

650 Route des Lucioles
F-06921 Sophia Antipolis Cedex - FRANCE

Tel.: +33 4 92 94 42 00 Fax: +33 4 93 65 47 16

Siret N° 348 623 562 00017 - APE 7112B
Association à but non lucratif enregistrée à la
Sous-Préfecture de Grasse (06) N° w061004871

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Foreword

This European Standard (EN) has been produced by ETSI Technical Committee Digital Enhanced Cordless Telecommunications (DECT).

The present document is part 2 of a multi-part deliverable ([1] to [8]). Full details of the entire series can be found in part 1 [1].

Further details of the DECT system may be found in ETSI TR 101 178 [i.1] and ETSI ETR 043 [i.2].

National transposition dates	
Date of adoption of this EN:	23 March 2022
Date of latest announcement of this EN (doa):	30 June 2022
Date of latest publication of new National Standard or endorsement of this EN (dop/e):	31 December 2022
Date of withdrawal of any conflicting National Standard (dow):	31 December 2023

Modal verbs terminology

In the present document "**shall**", "**shall not**", "**should**", "**should not**", "**may**", "**need not**", "**will**", "**will not**", "**can**" and "**cannot**" are to be interpreted as described in clause 3.2 of the ETSI Drafting Rules (Verbal forms for the expression of provisions).

"**must**" and "**must not**" are **NOT** allowed in ETSI deliverables except when used in direct citation.

1 Scope

The present document is one of the parts of the specification of the Digital Enhanced Cordless Telecommunications (DECT) Common Interface (CI).

The present document specifies the physical channel arrangements. DECT physical channels are radio communication paths between two radio end points. A radio end point is either part of the fixed infrastructure, a privately owned Fixed Part (FP), typically a base station, or a Portable Part (PP), typically a handset. The assignment of one or more particular physical channels to a call is the task of higher layers.

The Physical Layer (PHL) interfaces with the Medium Access Control (MAC) layer, and with the Lower Layer Management Entity (LLME). On the other side of the PHL is the radio transmission medium which has to be shared extensively with other DECT users and a wide variety of other radio services. The tasks of the PHL can be grouped into five categories:

a) to modulate and demodulate radio carriers with a bit stream of a defined rate to create a radio frequency channel;

b) to acquire and maintain bit and slot synchronization between transmitters and receivers;

c) to transmit or receive a defined number of bits at a requested time and on a particular frequency;

d) to add and remove the synchronization field and the Z-field used for rear end collision detection;

e) to observe the radio environment to report signal strengths.

The present document includes New Generation DECT, a further development of the DECT standard introducing wideband speech, improved data services, new slot types and other technical enhancements.

2 References

2.1 Normative references

References are either specific (identified by date of publication and/or edition number or version number) or non-specific. For specific references, only the cited version applies. For non-specific references, the latest version of the referenced document (including any amendments) applies.

Referenced documents which are not found to be publicly available in the expected location might be found at https://docbox.etsi.org/Reference/.

NOTE: While any hyperlinks included in this clause were valid at the time of publication, ETSI cannot guarantee their long term validity.

The following referenced documents are necessary for the application of the present document.

[1] ETSI EN 300 175-1: "Digital Enhanced Cordless Telecommunications (DECT); Common Interface (CI); Part 1: Overview".

[2] Void.

[3] ETSI EN 300 175-3: "Digital Enhanced Cordless Telecommunications (DECT); Common Interface (CI); Part 3: Medium Access Control (MAC) layer".

[4] ETSI EN 300 175-4: "Digital Enhanced Cordless Telecommunications (DECT); Common Interface (CI); Part 4: Data Link Control (DLC) layer".

[5] ETSI EN 300 175-5: "Digital Enhanced Cordless Telecommunications (DECT); Common Interface (CI); Part 5: Network (NWK) layer".

[6] ETSI EN 300 175-6: "Digital Enhanced Cordless Telecommunications (DECT); Common Interface (CI); Part 6: Identities and addressing".

[7] ETSI EN 300 175-7: "Digital Enhanced Cordless Telecommunications (DECT); Common Interface (CI); Part 7: Security features".

[8] ETSI EN 300 175-8: "Digital Enhanced Cordless Telecommunications (DECT); Common Interface (CI); Part 8: Speech and audio coding and transmission".

[9] ETSI EN 300 176-1: "Digital Enhanced Cordless Telecommunications (DECT); Test specification; Part 1: Radio".

[10] Recommendation ITU-R M.1457-15: "Detailed specifications of the terrestrial radio interfaces of International Mobile Telecommunications-2000 (IMT-2000)".

[11] Recommendation ITU-T V.11: "Electrical characteristics for balanced double-current interchange circuits operating at data signalling rates up to 10 Mbit/s".

[12] Federal Communications Commission FCC 02-151: "Second Report and Order, Amendment of Part 15 of the Commission's Rules Regarding Spread Spectrum Devices".

[13] CEPT/ECC/DEC/(06)01: "ECC Decision of 24 March 2006 amended 02 November 2012 on the harmonised utilisation of the bands 1920-1980 MHz and 2110-2170 MHz for mobile/fixed communications networks (MFCN) including terrestrial IMT systems".

2.2 Informative references

References are either specific (identified by date of publication and/or edition number or version number) or non-specific. For specific references, only the cited version applies. For non-specific references, the latest version of the referenced document (including any amendments) applies.

NOTE: While any hyperlinks included in this clause were valid at the time of publication, ETSI cannot guarantee their long term validity.

The following referenced documents are not necessary for the application of the present document but they assist the user with regard to a particular subject area.

[i.1] ETSI TR 101 178: "Digital Enhanced Cordless Telecommunications (DECT); A High Level Guide to the DECT Standardization".

[i.2] ETSI ETR 043: "Digital Enhanced Cordless Telecommunications (DECT); Common Interface (CI); Services and facilities requirements specification".

[i.3] International Commission on Non-Ionizing Radiation Protection (ICNIRP): "Guidelines for limiting exposure to time-varying electric, magnetic, and electromagnetic fields (up to 300 GHz), Health Physics", vol. 74, pp 494-522, April 1998.

[i.4] Council Recommendation 1999/519/EC of 12 July 1999 on the limitation of exposure of the general public to electromagnetic fields (0 Hz to 300 GHz) (Official Journal of the European Communities, July 1999).

[i.5] EN 50360: "Product standard to demonstrate the compliance of mobile phones with the basic restrictions related to human exposure to electromagnetic fields (300 MHz - 3 GHz)", produced by European Committee for Electrotechnical Standardization (CENELEC), July 2001. (Harmonised standard listed under the R&TTE directive).

[i.6] EN 50385: "Product standard to demonstrate the compliance of radio base stations and fixed terminal stations for wireless telecommunication systems with the basic restrictions or the reference levels related to human exposure to radio frequency electromagnetic fields (110 MHz - 40 GHz) - General public", produced by European Committee for Electrotechnical Standardization (CENELEC), November 2001 (draft).

[i.7] EN 50383: "Basic standard for the calculation and measurement of electromagnetic field strength and SAR related to human exposure from radio base stations and fixed terminal stations for wireless telecommunication systems (110 MHz - 40 GHz)", produced by European Committee for Electrotechnical Standardization (CENELEC), November 2001 (draft).

[i.8] IEEE 802.11b™: "Standard for Information Technology - Telecommunications and Information Exchange Between Systems - Local and Metropolitan Area Networks - Specific Requirements - Part 11: Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY) Specifications".

3 Definition of terms, symbols and abbreviations

3.1 Terms

For the purposes of the present document, the following terms apply:

antenna diversity: See ETSI EN 300 175-1 [1].

cell: See ETSI EN 300 175-1 [1].

Central Control Fixed Part (CCFP): See ETSI EN 300 175-1 [1].

channel: See ETSI EN 300 175-1 [1].

cluster: See ETSI EN 300 175-1 [1].

Connection Oriented mode (C/O): See ETSI EN 300 175-1 [1].

Cordless Radio Fixed Part (CRFP): See ETSI EN 300 175-1 [1].

coverage area: See ETSI EN 300 175-1 [1].

DECT Network (DNW): See ETSI EN 300 175-1 [1].

double duplex bearer: See ETSI EN 300 175-1 [1].

double simplex bearer: See ETSI EN 300 175-1 [1].

double slot: See ETSI EN 300 175-1 [1].

down-link: See ETSI EN 300 175-1 [1].

duplex bearer: See ETSI EN 300 175-1 [1].

Fixed Part (DECT Fixed Part) (FP): See ETSI EN 300 175-1 [1].

Fixed radio Termination (FT): See ETSI EN 300 175-1 [1].

frame: See ETSI EN 300 175-1 [1].

full slot (slot): See ETSI EN 300 175-1 [1].

guard space: See ETSI EN 300 175-1 [1].

half slot: See ETSI EN 300 175-1 [1].

handover: See ETSI EN 300 175-1 [1].

IMT-2000: International Mobile Telecommunications, Third Generation Mobile Systems

IMT-FT: International Mobile Telecommunications, FDMA/TDMA

NOTE: This is the DECT family member of IMT-2000.

intercell handover: See ETSI EN 300 175-1 [1].

intracell handover: See ETSI EN 300 175-1 [1].

Lower Layer Management Entity (LLME): See ETSI EN 300 175-1 [1].

multiframe: See ETSI EN 300 175-1 [1].

new Generation DECT: See ETSI EN 300 175-1 [1].

physical channel (channel): See ETSI EN 300 175-1 [1].

Portable Part (DECT Portable Part) (PP): See ETSI EN 300 175-1 [1].

Portable radio Termination (PT): See ETSI EN 300 175-1 [1].

public access service: See ETSI EN 300 175-1 [1].

radio channel: See ETSI EN 300 175-1 [1].

radio end point: See ETSI EN 300 175-1 [1].

Radio Fixed Part (RFP): See ETSI EN 300 175-1 [1].

Repeater Part (REP): See ETSI EN 300 175-1 [1].

RF carrier (carrier): See ETSI EN 300 175-1 [1].

RF channel: See ETSI EN 300 175-1 [1].

simplex bearer: See ETSI EN 300 175-1 [1].

Single Radio Fixed Part (SRFP): See ETSI EN 300 175-1 [1].

TDMA frame: See ETSI EN 300 175-1 [1].

Wireless Relay Station (WRS): See ETSI EN 300 175-1 [1].

3.2 Symbols

Void.

3.3 Abbreviations

For the purposes of the present document, the following abbreviations apply:

AC	Accuracy
AM	Amplitude Modulation
BER	Bit Error Rate
BT	Bandwidth Time product (Gaussian filters)
CCFP	Central Control Fixed Part
CI	Common Interface (standard)
CRC	Cyclic Redundancy Check
CRFP	Cordless Radio Fixed Part
CTA	Cordless Terminal Adapter
dBm	dB relative to 1 milliwatt
DBPSK	Differential Binary Phase Shift Keying
DC	Direct Current
DLC	Data Link Control layer
DNW	DECT NetWork
DPSK	Differential Phase Shift Keying
DQPSK	Differential Quaternary Phase Shift Keying
D-SAP	Data field-Service Access Point
DSV	Digital Sum Variation
EIRP	Equivalent Isotropically Radiated Power
ERP	Effective Radiated Power
EVM	Error-Vector Magnitude
FMID	Fixed part MAC IDentity
FP	Fixed Part

FT	Fixed radio Termination
Fy	Frequency
GFSK	Gaussian Frequency Shift Keying
GMSK	Gaussian Minimum Shift Keying
GPS	Global Positioning System
HLM	High Level Modulation
ICNIRP	International Commission on Non-Ionizing Radiation Protection
iDCS	instant Dynamic Channel Selection
IMT-FT	International Mobile Telecommunications - Frequency Time
ISM	Industrial, Scientific and Medical
ITU-T	International Telecommunication Union - Telecommunication
LCD	Largest Common Denominator
LLME	Lower Layer Management Entity
MAC	Medium Access Control layer
MCM	Minimum Common Multiple
ME	Management Entity
MF	Fading Margin
MFN	MultiFrame Number
MT	MAC control channel on A-tail field, or one message on such channel
NTP	Normal Transmitted Power
NWK	NetWorK
PCMCIA	Personal Computer Memory Card International Association
PHL	Physical Layer
PM-SAP	Physical layer Management entity - Service Access Point
PP	Portable Part
ppm	parts per million
PSCN	Primary receiver Scan Carrier Number
PT	Portable radio Termination
QAM	Quadrature Amplitude Modulation
QT	system information and Multiframe marker (MAC logical channel)
REP	Repeater Part
RF	Radio Frequency
RFP	Radio Fixed Part
RMS	Root Mean Square
RPN	Radio fixed Part Number
RSS	Radio Signal Strength
RSSp	Radio Signal Strength PP
SAP	Service Access Point
SAR	Specific Absorption Rate
SDU	Service Data Unit
SRFP	Single Radio Fixed Part
TDD	Time Division Duplex
TDM	Time Division Multiplex
TDMA	Time Division Multiple Access
UMTS	Universal Mobile Telecommunication System
UTC	Universal Time Coordinated
VF	cable Velocity Factor
WLAN	Wireless Local Area Network
WLL	Wireless Local Loop
WRS	Wireless Relay Station

4 PHL services

4.0 General

A physical channel provides a simplex bit-pipe between two radio end points. To establish, for example, a duplex telephone connection, two physical channels have to be established between the endpoints.

Radio spectrum is needed to create a physical channel. The radio spectrum space has three dimensions:

- geometric (geographic) space;
- frequency;
- time.

Spectrum is assigned to physical channels by sharing it in these three dimensions.

DECT provides a mechanism called "handover" to release a physical channel and to establish another one in any or all of the three dimensions without releasing the end-to-end connection.

The requirements of the present document should be read in conjunction with ETSI EN 300 176-1 [9].

The requirements specified apply for nominal conditions unless extreme conditions are stated. Tests at extreme conditions may include combinations of limit values of extreme temperature and of power supply variation, defined for each case in ETSI EN 300 176-1 [9].

Nominal and extreme temperature ranges are defined below:

Nominal temperature:	PP, FP, RFP, CCFP	+15 °C to +35 °C;
Extreme temperature:	PP	0 °C to +40 °C;
	FP, RFP, CCFP, class E1	+10 °C to +40 °C;
	FP, RFP, CCFP, class E2	-10 °C to +55 °C.

The environmental class E1 refers to installation in indoor heated and/or cooled areas allowing for personal comfort, e.g. homes, offices, laboratories or workshops. The environmental class E2 refers to all other installations.

For nominal temperature, each measurement is made at the temperature of the test site, which shall be within +15 °C to +35 °C. For extreme temperatures, additional measurements are made, at each limit value of the extreme temperature.

4.1 RF channels (access in frequency)

4.1.1 Nominal position of RF carriers

DECT carriers are specified for the whole frequency range 1 880 MHz to 1 980 MHz and 2 010 MHz to 2 025 MHz. Carrier positions in the 902 MHz to 928 MHz ISM band and the 2 400 MHz to 2 483,5 MHz ISM band have been defined for the US market [12].

DECT is also an IMT-2000 [10] family member, called IMT-FT, the only member that provides for uncoordinated installations on an unlicensed spectrum. RF carriers for IMT-FT applications of DECT are placed within the parts of the European UMTS spectrum applicable for TDD operation (see ECC/DEC/(06)01 [13]). E.g. within 1 900 MHz to 1 920 MHz, 1 920 MHz to 1 980 MHz and/or 2 010 MHz to 2 025 MHz.

The most common spectrum allocation is 1 880 MHz to 1 900 MHz, but outside Europe spectrum is also available in 1 900 MHz to 1 920 MHz and in 1 910 MHz to 1 930 MHz (several countries).

Ten RF carriers are defined in the frequency band 1 880 MHz to 1 900 MHz with centre frequencies Fc given by:

$$Fc = F0 - c \times 1{,}728 \text{ MHz};$$

where: $F0 = 1\,897{,}344$ MHz; and

$c = 0,1, ..., 9$.

Above this band, additional carriers are defined in annex F. Annex F shows the carrier frequencies for c = 0 to 9 and for c ≥ 10 and RF bands 00001 to 01001 (see ETSI EN 300 175-3 [3], clauses 7.2.3.3 and 7.2.3.9).

The frequency band between Fc - 1,728/2 MHz and Fc + 1,728/2 MHz shall be designated RF channel c.

NOTE: A nominal DECT RF carrier is one whose centre frequency is generated by the formula: Fg = F0 - g × 1,728 MHz, where g is any integer.

All DECT equipment should when allowed be capable of working on all 10 RF channels, c = 0, 1, ..., 9.

New or modified carrier positions and/or frequency bands can (locally) be defined when needed by utilizing reserved RF band numbers.

4.1.2 Accuracy and stability of RF carriers

At an RFP the transmitted RF carrier frequency corresponding to RF channel c shall be in the range Fc ± 50 kHz at extreme conditions.

At a PP the centre frequency accuracy shall be within ±50 kHz at extreme conditions either relative to an absolute frequency reference or relative to the received carrier, except that during the first 1 s after the transition from the idle-locked state to the active-locked state the centre frequency accuracy shall be within ±100 kHz at extreme conditions relative to the received carrier.

NOTE: The above state transition is defined in ETSI EN 300 175-3 [3].

The maximum rate of change of the centre frequency at both the RFP and the PP while transmitting, shall not exceed 15 kHz per slot.

4.2 Time Division Multiple Access (TDMA) structure (access in time)

4.2.1 Frame, full-slot, double-slot, half-slot and variable capacity slot structure (including long slot)

To access the medium in time, a regular TDMA structure is used. The structure repeats in frames of 11 520 symbols, and the data is transmitted at a symbol rate of 1 152 ksymbol/s. Within this frame 24 full-slots are created, each consisting of two half-slots. A double slot has a length of two full slots, and starts concurrently with a full slot (see figures 1 to 3).

NOTE 1: Some DECT documents sometimes refer to bits instead of symbols due to the fact that symbol and bit become synonyms for the mandatory 2-level modulation, for which most physical layer tests are defined, see ETSI EN 300 176-1 [9].

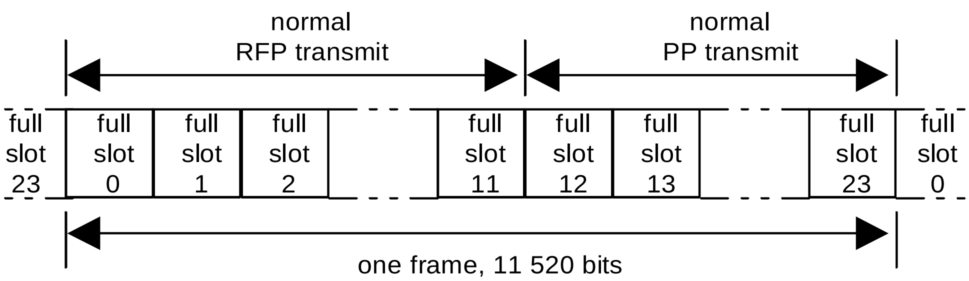

Figure 1: Full slot format

Full-slots are numbered from K = 0 to 23, and half-slots are numbered L = 0 or 1, where half-slot 0 occurs earlier than half-slot 1. Normally full-slots K = 0 to 11 are used in the RFP to PP direction, while full slots K = 12 to 23 are normally used in the PP to RFP direction. Double slots are numbered K = 0 to 10 and from 12 to 22. There is no double slot 11 due to the TDM structure imposed on the DECT frame.

Each full-slot has a duration of 480 symbol intervals. Symbol intervals within a full-slot are denoted f0 to f479 where interval f0 occurs earlier than interval f1. Each half-slot has a duration of 240 symbol intervals. Half-slots commence at f0 or f240 (see figure 2).

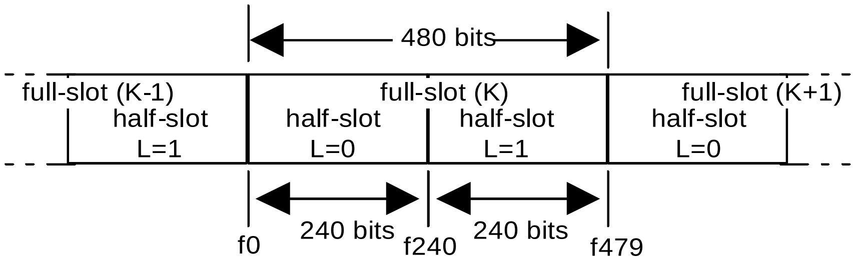

Figure 2: Half-slot format

Each double slot has a duration of 960 symbol intervals. Symbol intervals within a double slot are denoted f0 to f959. Symbols f0 to f479 coincide with the same notation for full slots with K<>11.

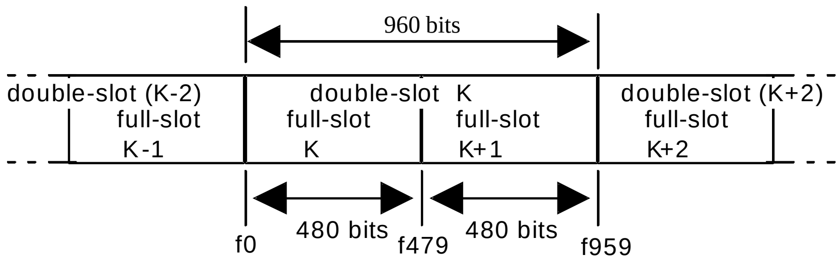

Figure 3: Double slot format

NOTE 2: Each radio end point has its own timing of the TDMA structure due to propagation delay and non-synchronized systems.

The variable capacity slot (P00j) allows implementing slot lengths different of the half, full and double structures.

A variable capacity slot (P00j) has a duration of 100+j or 104+j data symbols.

Symbol intervals within a variable capacity slot are denoted p0 to p103+j:

For j = 80, this slot structure becomes similar to the half slot, and for j ≤ 80, this structure becomes a shortened half slot (see note 3).

In case of j ≤ 136, the beginning of symbol p0 coincides either with the beginning of symbol interval f0 or the beginning of symbol interval f240 of the full-slot structure (see figure 2).

For 136 < j < 320 this structure becomes a shortened full slot.

For j = 320, this slot structure becomes the full slot (see note 4).

For 320 < j < 800 this slot structure becomes an extended full slot.

For j = 800, this structure becomes similar to the double slot (see note 3), and has the format shown in figure 3.

The maximum possible value of j is 856. For 800 < j ≤ 856, this structure becomes an extended double slot.

In all cases with j > 136, the beginning of symbol p0 coincides with the beginning of symbol interval f0 of the full-slot.

The variable capacity slot is named "long slot" in case of j = 640 or j = 672. The "long slots" (j = 640 or j = 672) are particular cases of the variable capacity slot and are equivalent to extended full slots.

NOTE 3: The X-CRC generation schemes for variable capacity slots are different from those used for half and double slots (see clause 6.2.5.4 of ETSI EN 300 175-3 [3]).

NOTE 4: The X-CRC generation schemes for variable capacity slots and for full slot are the same.

NOTE 5: This overview applies only to 2-level modulation.