DECT

(DECT = Digital Enhanced Cordless Telecommunication)
(previously: Digital European Cordless Telephone)
(Japanese alternative: PHS = Personal Handy phone System)

• more than a simple cordless terminal system!
• 4 basic applications (cordless system, PABX extension, WLL connection, CTM)
• TDD duplex structure (basics, advantages)
Four application examples of DECT:

1) Cordless system (residential use), only one base station, only intracell handover

2) PABX wireless extension (business use, e.g., HUT), many base stations, intracell & intercell handover

3) WLL (Wireless Local Loop) connection, instead of wired access lines for connecting users to the PSTN/ISDN

4) CTM (Cordless Terminal Mobility), wide area mobility
Residential use (DECT as cordless terminal)

To PSTN / ISDN network

Only one base station, limited mobility, inter-PP traffic
Business use (PABX wireless extension)

e.g., ISDN PRA

Intercell handover between base stations is possible
Wireless local loop (WLL) applications

Up to 5 km possible (utilizing directional antennas, etc.)
Cordless Terminal Mobility (CTM)

=> Portability over a wider area

Examples:

1. Same DECT terminal can be used at home and in office

2. DECT terminal can be used at several locations in a city (no handover functionality between these locations)
Success of DECT?
(year: 2000; source: DECT Forum)

Residential:
- 25 million terminals sold worldwide
- 60% of all cordless terminals are DECT
- 90% in Europe, especially Germany

Business:
- 1 million handsets in business use
- almost $10^5$ multicell systems installed

WLL:
- more than 1 million lines installed
- popular especially outside Europe
TDD (Time Division Duplex) system
(GSM ⇔ FDD, 3G systems ⇔ FDD, TDD)

DECT is a TDD system, which means that down- and uplink use the same frequency (but different time slots).

Frequency band of DECT:

1880 - 1900 (MHz)

Two advantages of TDD: (w.r.t. FDD)
- can adapt to asymmetric traffic
- reciprocal radio channel
FDMA / TDMA system

Like GSM, DECT is a FDMA/ TDMA system. The multiple access structure uses $10 \times 12 = 120$ bi-directional channels. Each channel can carry 32 kbits/s.

10 frequencies (FDMA)

24 time slots / frame (TDMA)

time slot 9 in downlink
time slot 21 in uplink
TDD $\Leftrightarrow$ reciprocal radio channel

FDD system (e.g., GSM): Signal fading due to multipath propagation is different in uplink and downlink.

TDD system (e.g., DECT): Multipath fading is exactly the same in uplink and downlink.
Multipath mechanism of fading

Suppose the signal arrives via two propagation paths at the receiver, and the received signal replicas have the same strength ($a$) but arrive after different delays ($\tau_1$ and $\tau_2$)

At frequency $f_1$:

$$r_1(t) = a(e^{j2\pi f_1 \tau_1} + e^{j2\pi f_1 \tau_2})e^{j2\pi f_1 t}$$

At frequency $f_2$:

$$r_2(t) = a(e^{j2\pi f_2 \tau_1} + e^{j2\pi f_2 \tau_2})e^{j2\pi f_2 t}$$

When $r_1(t)$ is fading, $r_2(t)$ may be strong (or vice versa), if the frequency and/or delay difference is sufficiently large.
Dynamic channel selection and allocation

1. All idle channels are scanned at regular intervals (30 s).
2. An RSSI (Received Signal Strength Indication) list is generated.
3. When a new channel is needed, the DECT terminal (PP) or base station (FP) selects an idle channel with minimum interference for this purpose, utilizing the RSSI list.
4. In this way, the interference level in the DECT network is kept as low as possible.
Mobile-controlled handover

MCHO ⇔ Handover is always initiated by the terminal / PP (PP = DECT portable part)

1) downlink interference => intracell handover to a better channel (at another frequency)

2) uplink interference => Base station (RFP) signals to terminal => intracell handover

3) intercell handover due to better quality connection to another base station
Intracell handover

Interference on channel 1 causes an intracell handover to channel 2
Intercell handover
GAP (Generic Access Profile)

Minimum mandatory requirements (October 1997) allow a 3.1 kHz teleservice connection to be established, maintained and released between FP and PP with the appropriate access rights, irrespective of whether the FP provides residential, business or public access services.

GIP – DECT/GSM Interworking Profile
IIP – DECT/ISDN Interworking Profile
RAP – Radio Local Loop Access Profile
CAP – CTM Access Profile
DSP  =>  DPRS = DECT Packet Radio Service (new!)
Security in DECT

1. User identification (PIN code)  DECT: ?
   GSM: yes

2. Authentication                 DECT: yes
   GSM: yes

3. Encryption of the air interface during transmission DECT: optional
   GSM: yes
Authentication

**Terminal**

- Challenge
- Random number
- Algorithm
- Authentication key

**Air**

- Response
- The same? If yes, continue

**Base station**

- Algorithm
- Authentication key
- Random number