TETRA

(TErrestrial Trunked RAdio)

Further information on TETRA:

www.tetramou.org ("official" site)

www.aeroflex.com/tetra/productinfo/TETRABackgrounder.ppt

Examples of digital wireless systems

(all originally specified by ETSI)

GSM (Global System for Mobile communication) is a *cellular mobile* system

- cellular concept
- high mobility (international roaming)

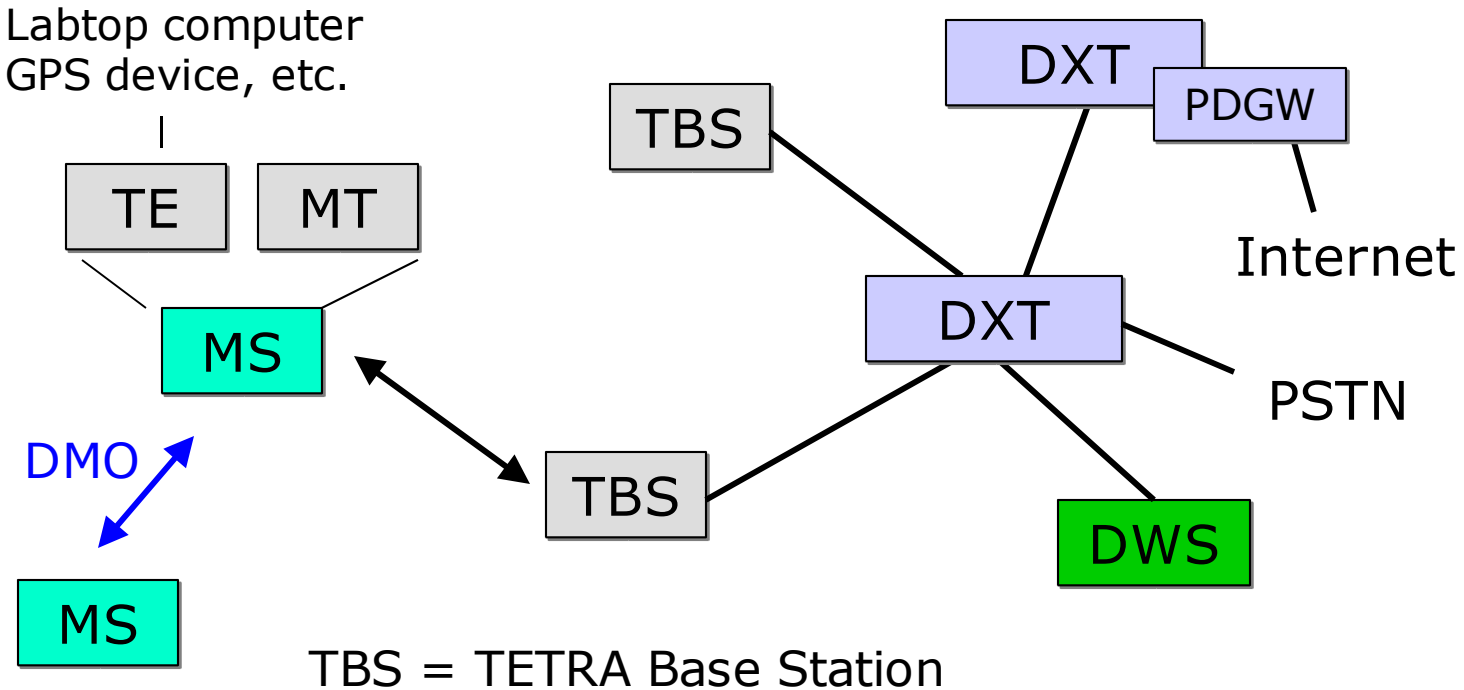
TETRA (TErrestrial Trunked RAdio) is an example of a *Professional/Privat Mobile Radio* (PMR) system

- limited access (mainly for professional usage)
- limited mobility (but other advanced features)

DECT (Digital Enhanced Cordless Telecommunications) is a *cordless* system

- low mobility (only within "isolated islands")

TETRA architecture



TBS = TETRA Base Station
DXT = Digital eXchange for TETRA
DWS = Dispatcher Work Station
PDGW = Packet Data GateWay
DMO = Direct Mode Operation

Standardisation

Public cellular mobile systems (like GSM) by necessity are open = multivendor systems (at least as far as the radio interface is concerned)

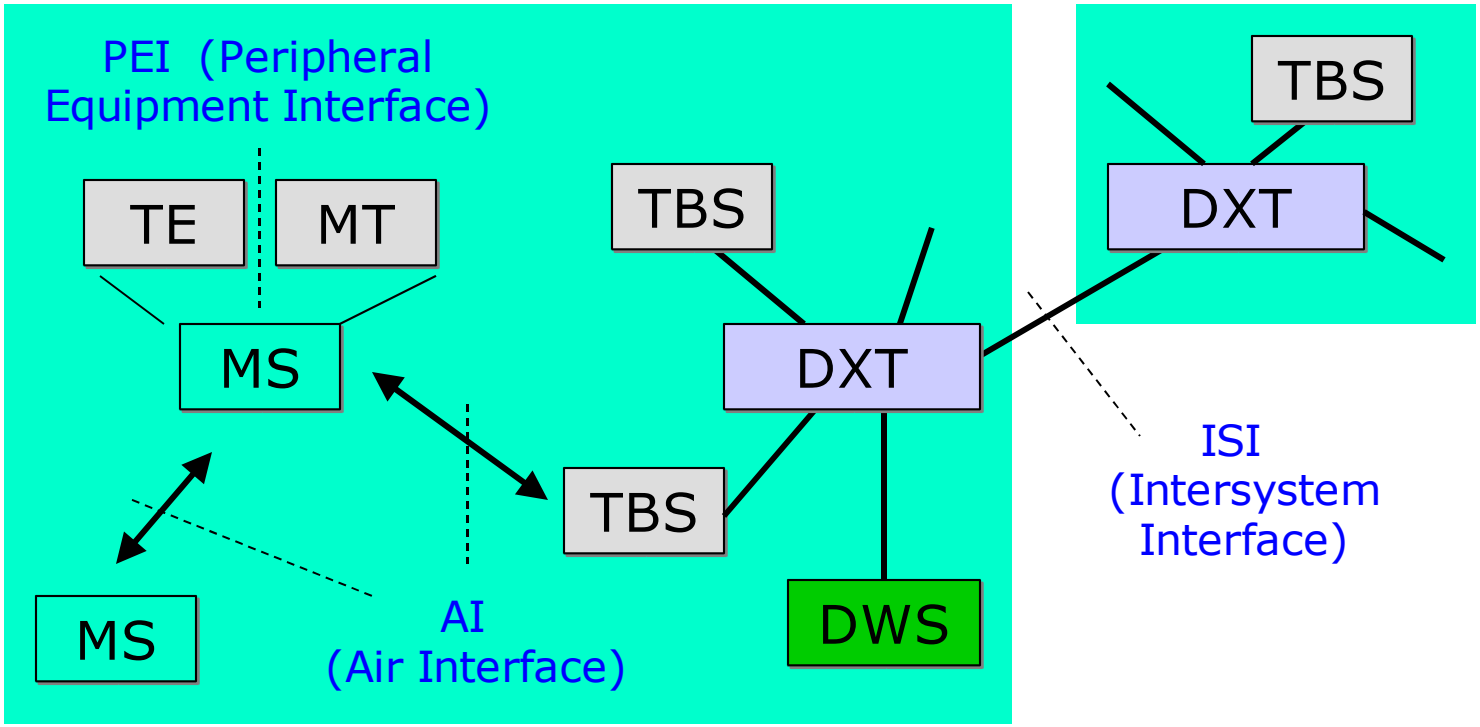
=> detailed standardisation necessary

PMR systems were traditionally single-vendor systems (one system for each authority...)

However, this is not considered a good solution any longer, and TETRA is the first open PMR system

=> standardised by ETSI

Open interfaces - multivendor systems



Important open interfaces: AI, PEI, ISI

Dispatcher, group calls

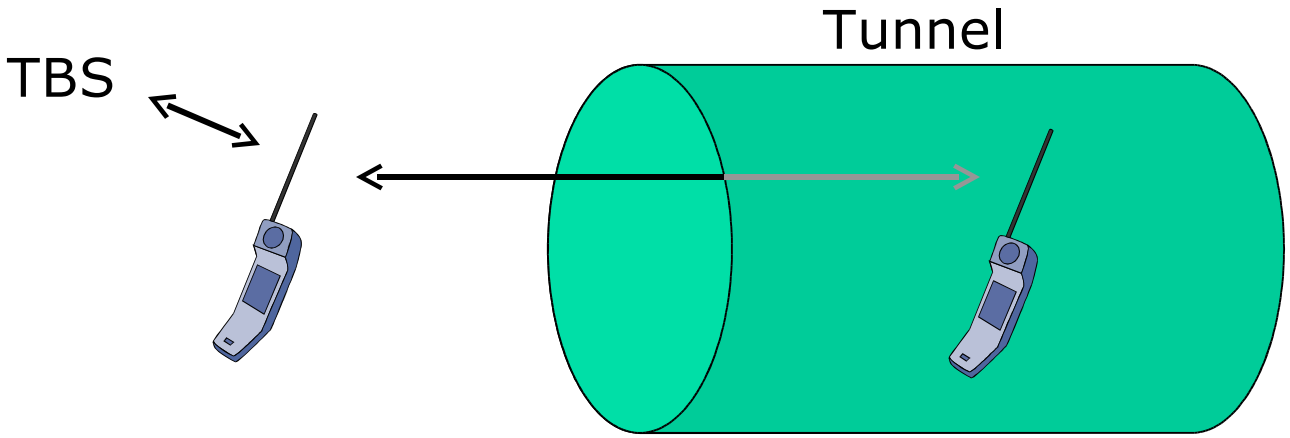
Dispatcher = a person who manages field operations via the network. The dispatcher distributes tasks to police forces, fire brigades, etc. The dispatcher

- can follow the field operations from a console (graphical workstation)
- can control the traffic in the network
- can supervise group calls

Group call = user pushes press-to-talk button and starts talking after which the others in this group can listen to this user at the same time (one-to-many voice communication)

Semi-duplex operation

Direct mode (DMO) feature



The possibility of direct MS-to-MS communication extends the range of operation of TETRA

(emergency situations, areas without cell coverage)

Three kinds of PMR networks

Public safety and security networks are typically nationwide networks providing PMR communications for police, fire, ambulance and other public rescue services. These networks are typically financed from public funds.

In Europe: 380...400 MHz band

Commercial networks are provided by an operator who sells the PMR service to professional companies like transportation, taxi and bus companies, security services, courier companies and similar organisations.

In Europe: 410...430 MHz band

Private networks are often small networks owned and operated by the organisations themselves.

TETRA vs. GSM (1)

Both systems have their strong sides:

Benefits of TETRA	Benefits of GSM
Security features	more advanced than in GSM
Group calls	not possible in GSM
Call setup delay	smaller than in GSM
Dispatcher station	not possible in GSM

TETRA vs. GSM (2)

Both systems have their strong sides:

Benefits of TETRA	Benefits of GSM
DMO (MS-to-MS)	not possible in GSM
Supplementary services	more advanced than in GSM
	Mass market => cheap equipment
not possible in TETRA	Global mobility/roaming

TETRA vs. GSM (3)

Some other issues:

TETRA	GSM
Radio frequency bands	
380...430 MHz (Europe) 800... (outside Europe)	900 MHz, 1800 MHz 1900 MHz (USA)
the smaller the radio frequency, the larger the maximum cell size	
Radio interface, technical details	
FDD, TDMA 4 slots/frame	FDD, TDMA 8 slots/frame

TETRA radio interface

Separation of uplink/downlink traffic: FDD (like GSM)

Carrier spacing: 25 kHz (compare: GSM => 200kHz)

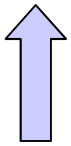
4 TDMA timeslots per frame on each carrier (GSM => 8 timeslots/frame)

Flexible bandwidth allocation:

1 … 4 timeslots per user

Several channel coding options
=> tradeoff: reliability vs. data rate

7.2 … 2.4 kbit/s

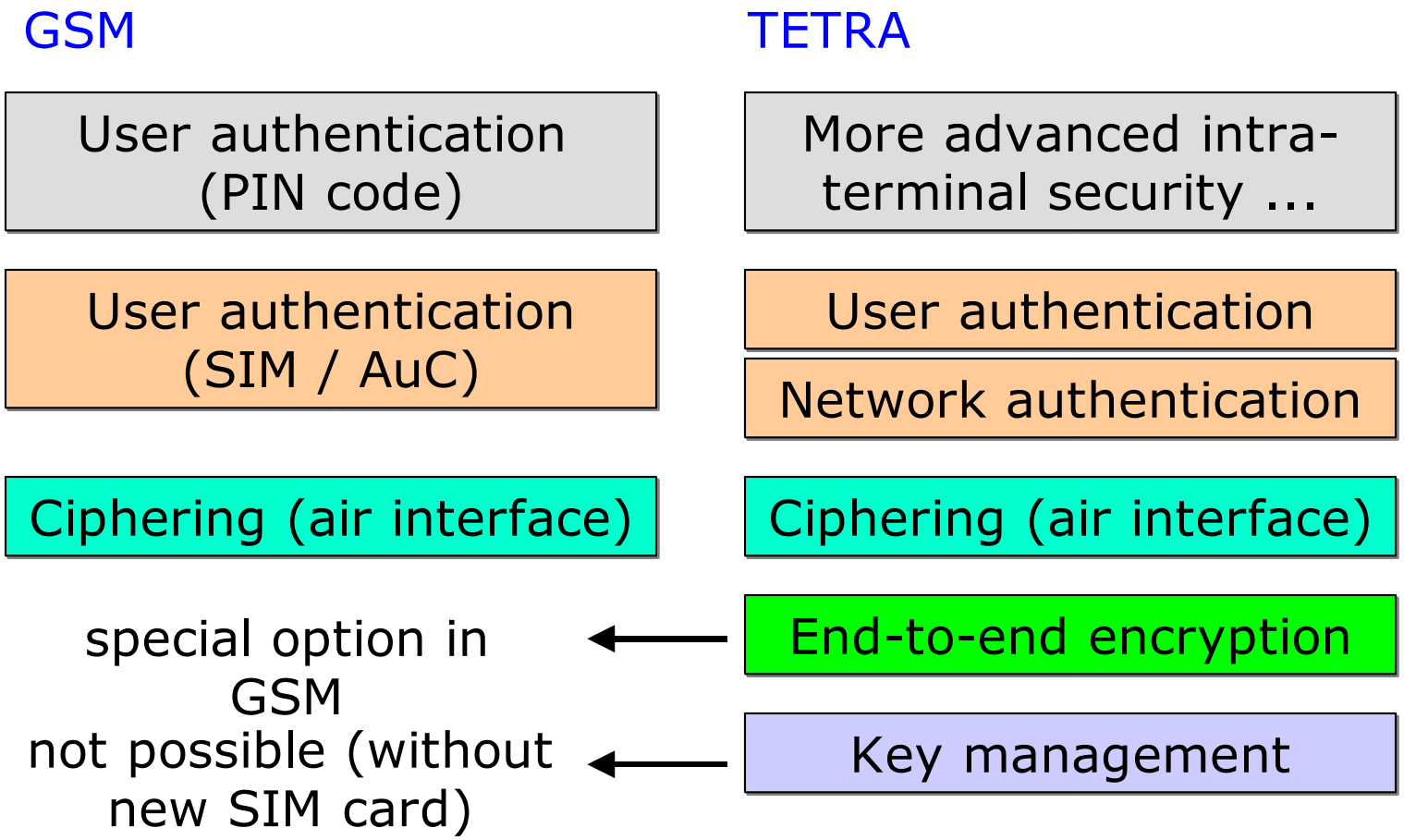


FDD, TDMA 4 slots/frame

no channel coding, unreliable

most reliable transmission option

Security


GSM
TETRA
User authentication (PIN code)
More advanced intra-terminal security ...
User authentication (SIM / AuC)
User authentication
Network authentication
Ciphering (air interface)
Ciphering (air interface)
special option in GSM not possible (without new SIM card)
End-to-end encryption
Key management

DECT

(Digital Enhanced Cordless Telecommunications)

Further information on DECT:

www.dect.ch ("official" site of DECT Forum)

www.handytel.com/technology/dect01.htm
(nice introduction to DECT)

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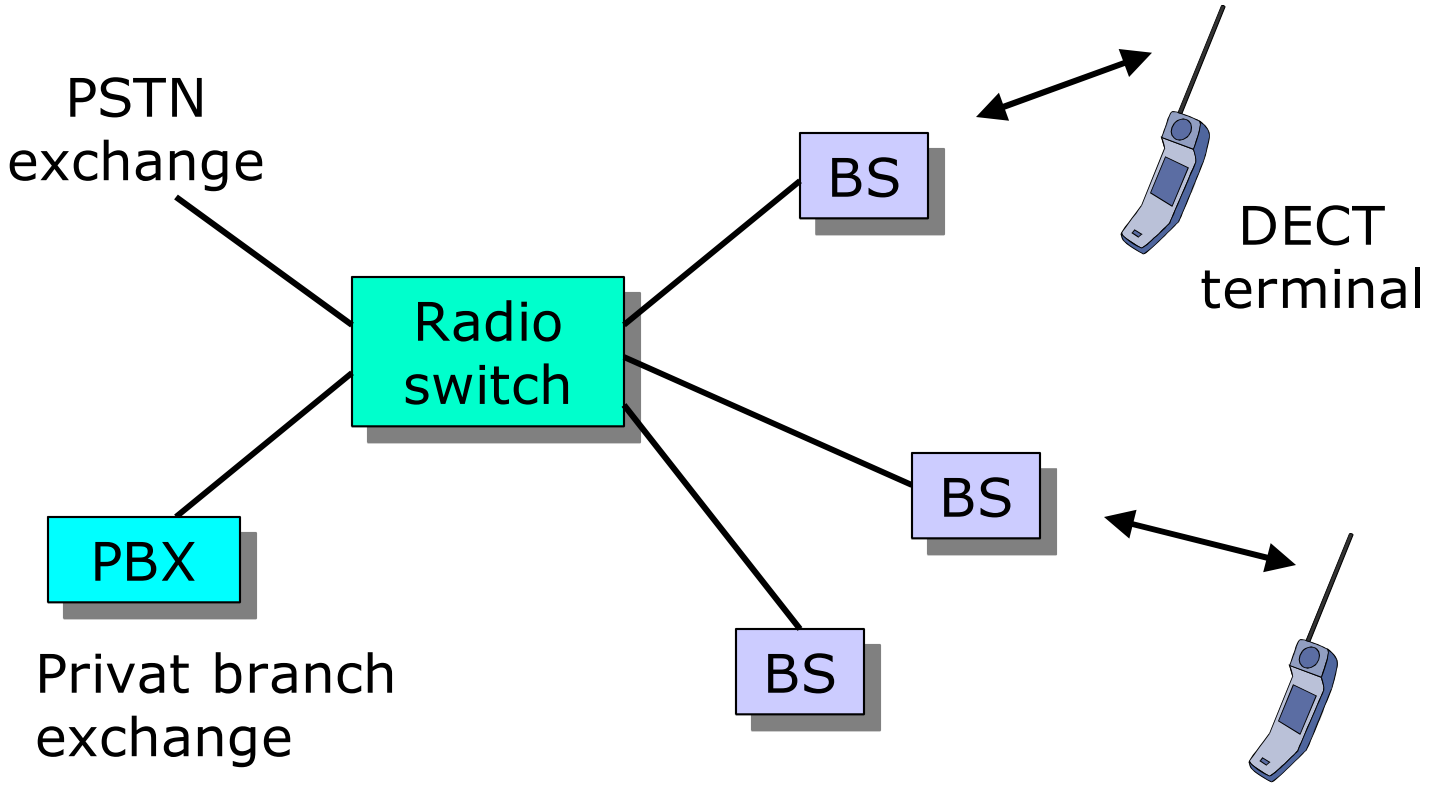
DECT Architecture



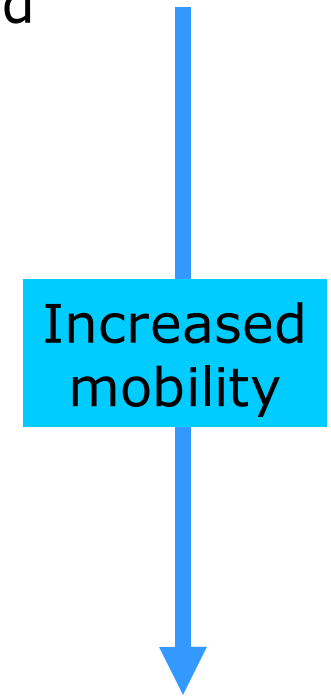
Four application examples of DECT

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

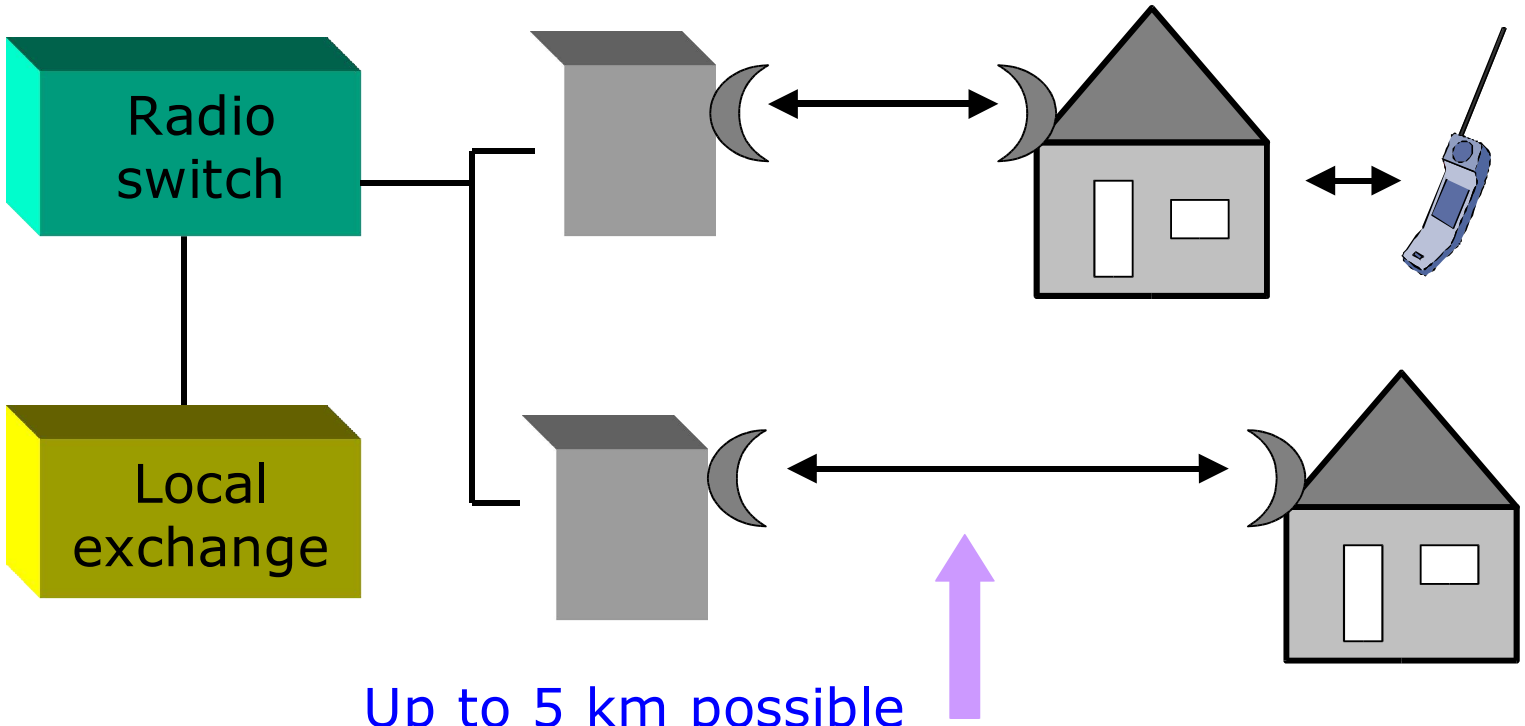
Cordless system (residential use), only one base station => only intracell handover

PABX wireless extension (business use, e.g. HUT), several base stations => intracell and intercell handover

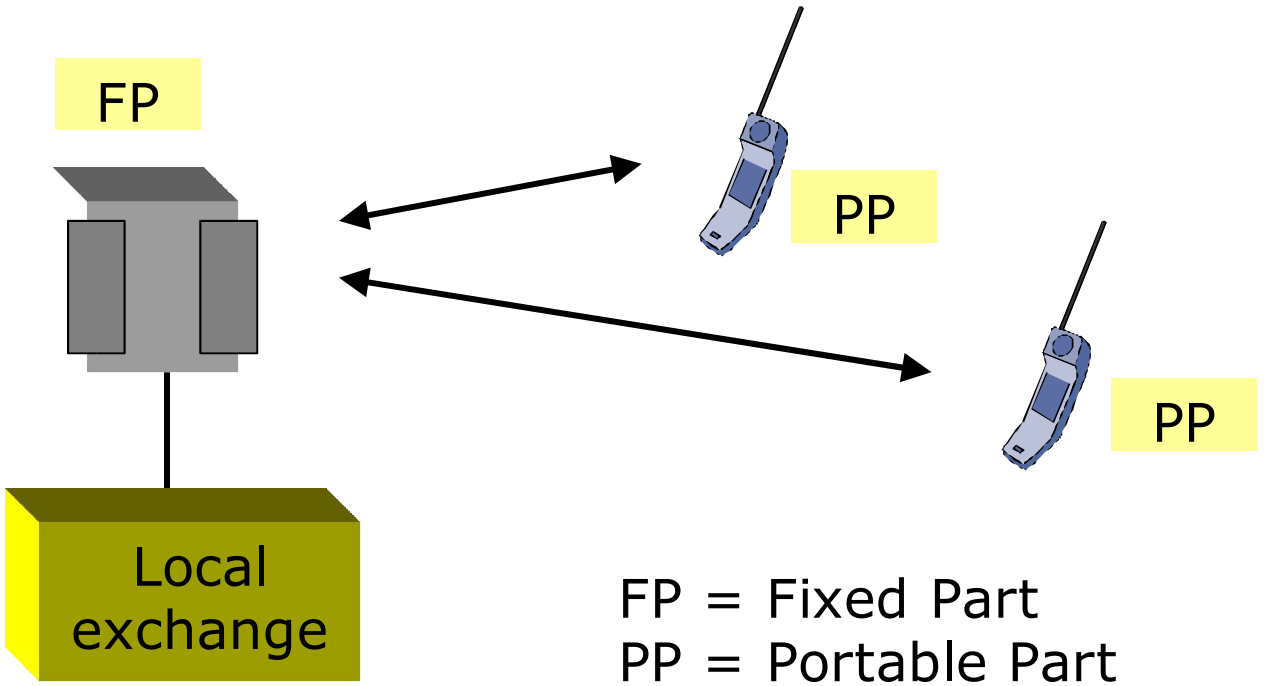
CTM (Cordless Terminal Mobility), wide area mobility



WLL (Wireless Local Loop)

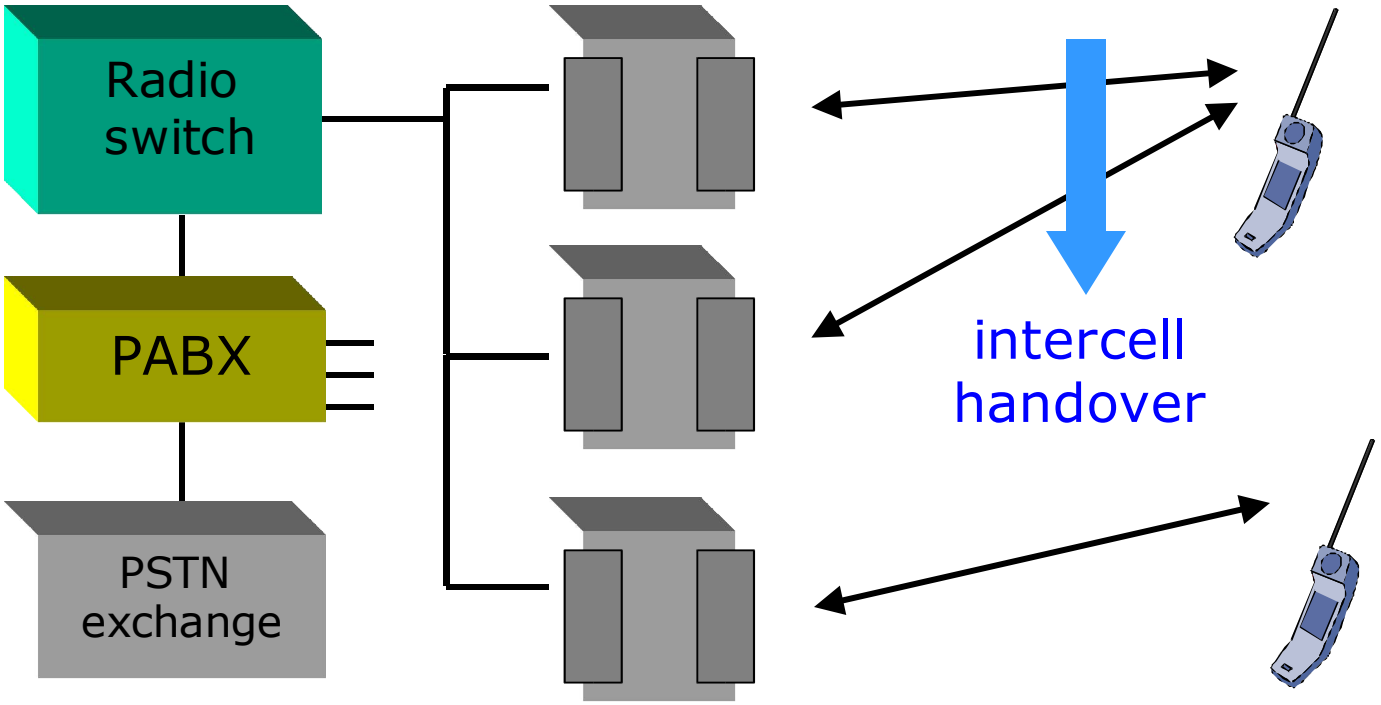


Cordless system



Only one base station (FP), inter-PP traffic possible

PABX wireless extension



Intercell handover between base stations is possible

Cordless Terminal Mobility (CTM)

=> Portability over a wider area

=> Public service

Examples:

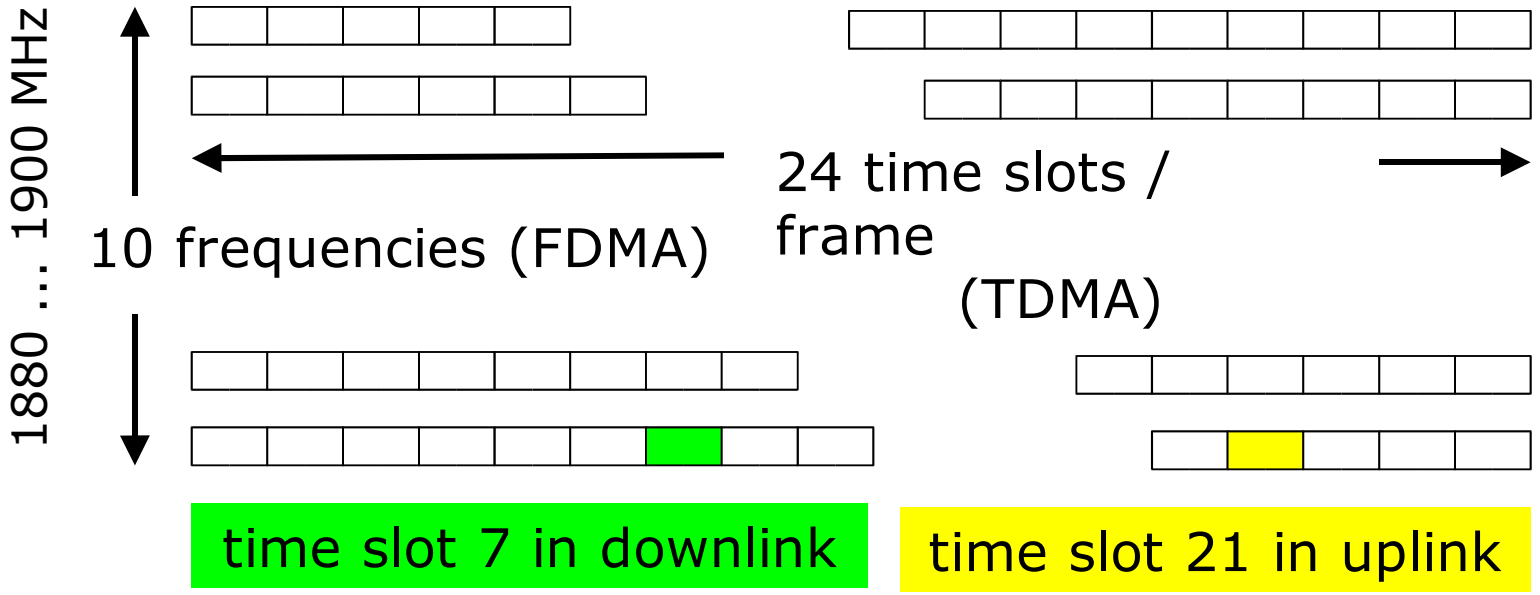
Same DECT terminal can be used at home and in the office

DECT terminal can be used at several locations in a city

However: no advanced mobility management like in GSM

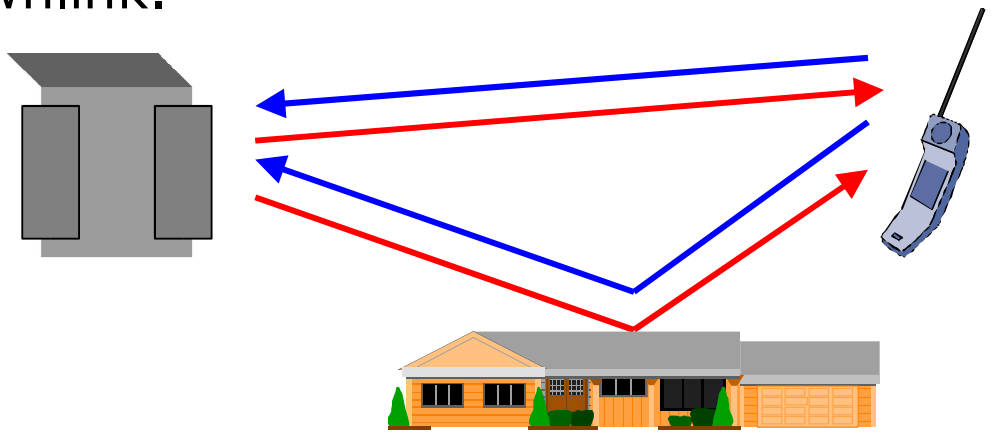
DECT is a TDD FDMA/TDMA system

Like GSM, DECT is a FDMA/TDMA system. Unlike GSM, however, DECT is based on TDD. The multiple access structure uses 10 x 12 = 120 bi-directional channels. Each channel can carry 32 kbits/s.



TDD <=> reciprocal radio channel

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



closed-loop power control needed

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

open-loop power control is sufficient

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.

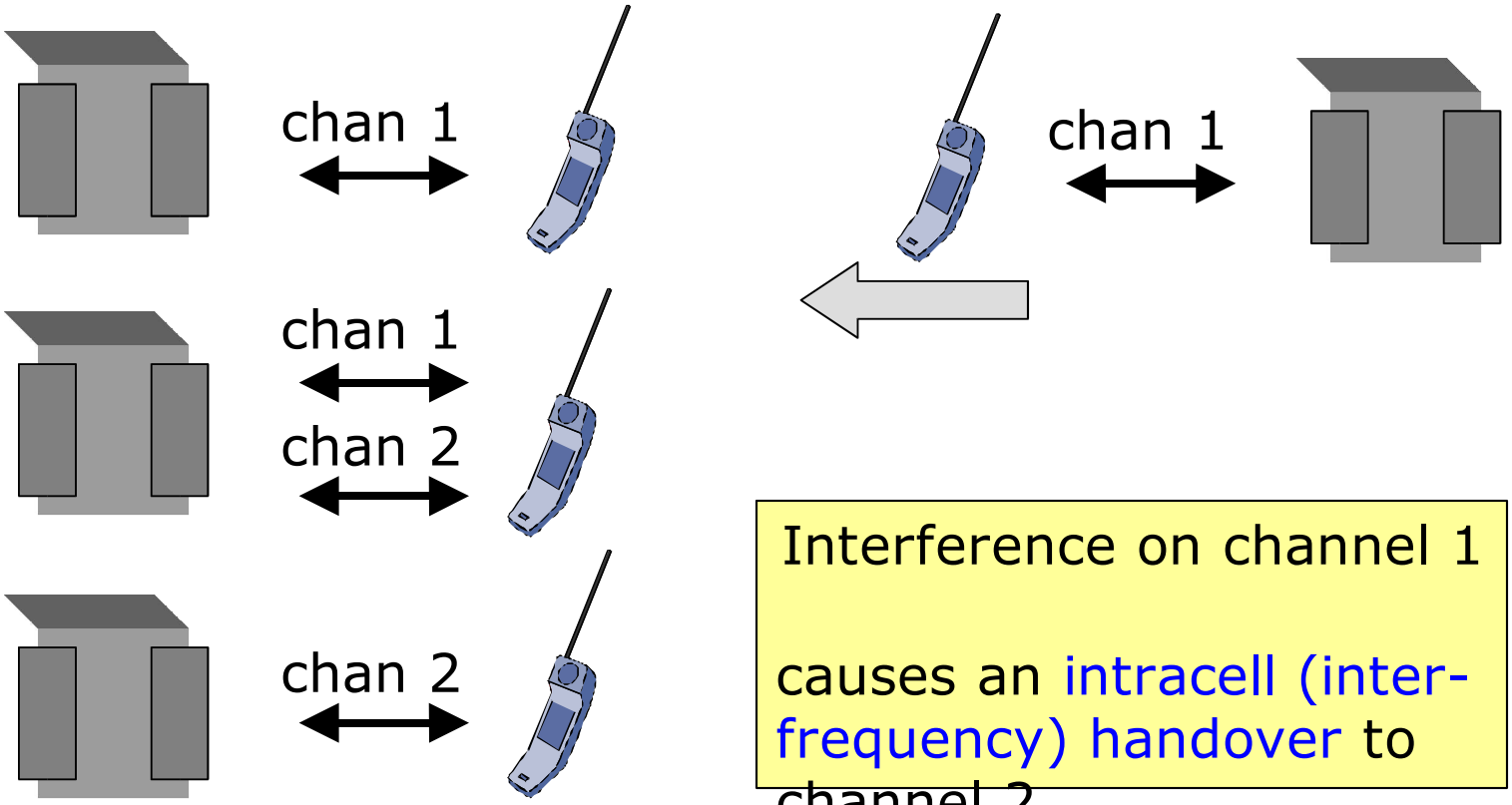
Mobile-controlled handover

MCHO ⇔ Handover is always initiated by the terminal

Downlink interference:	Intracell handover to a better channel at another frequency
Uplink interference:	Base station (FP) tells terminal to perform Intracell handover

Better quality connection to another base station => Intercell handover

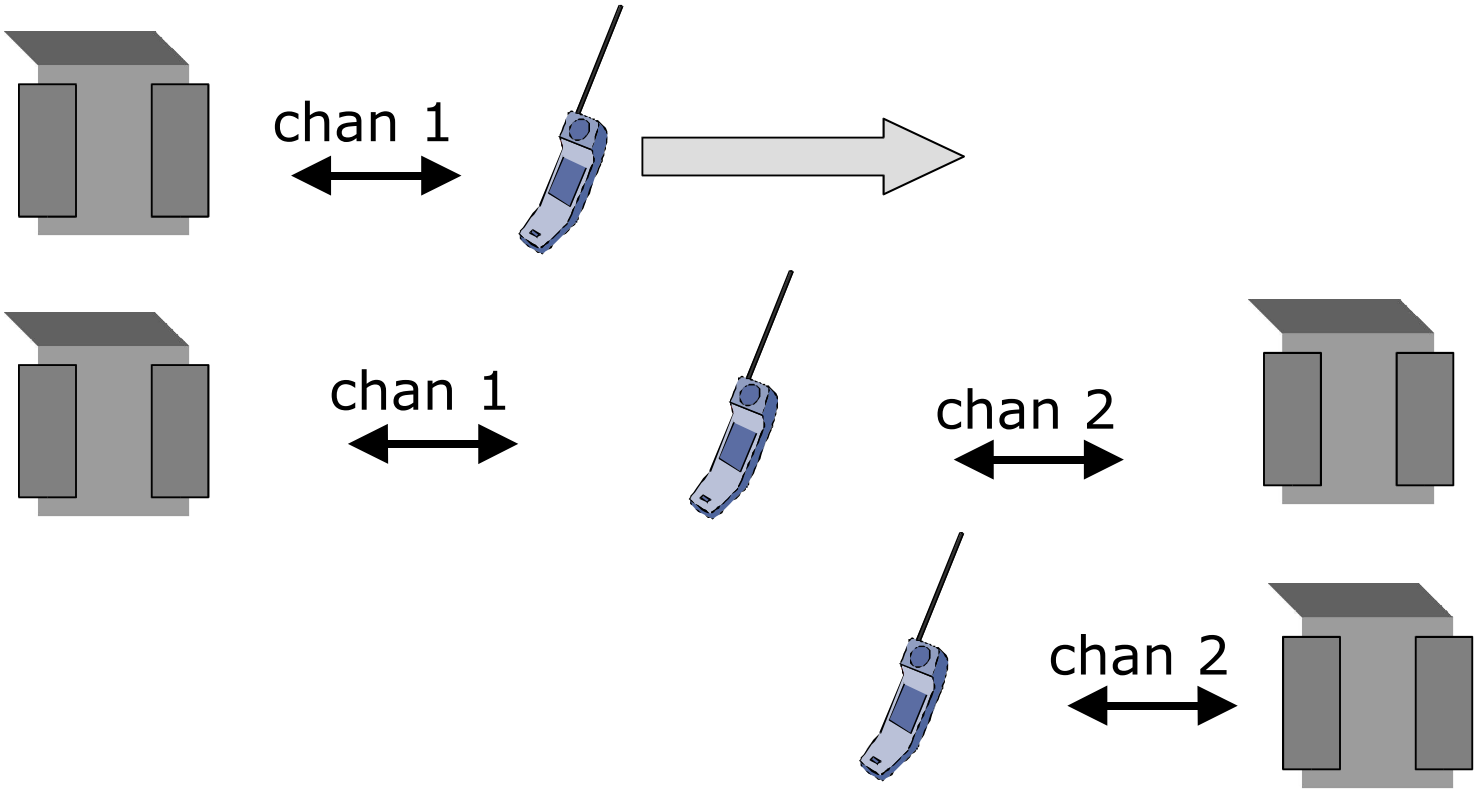
Intracell handover



Interference on channel 1

causes an intracell (inter-frequency) 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!)

other profiles

see: www.handytel.com/technology/dect01.htm