

Mobile Computing

Lecture 12

Digital Mobile Phone Systems 5



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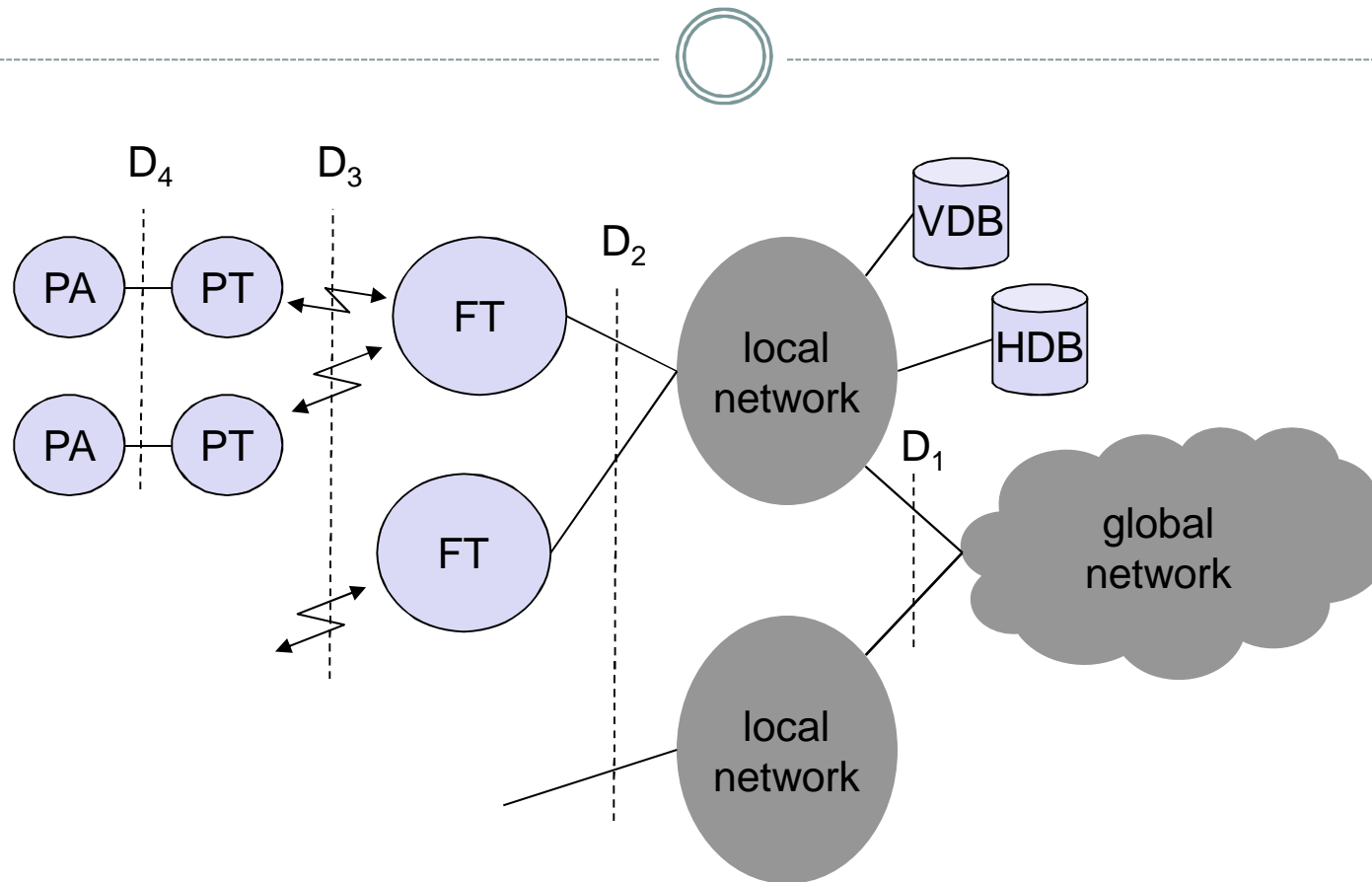
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DECT

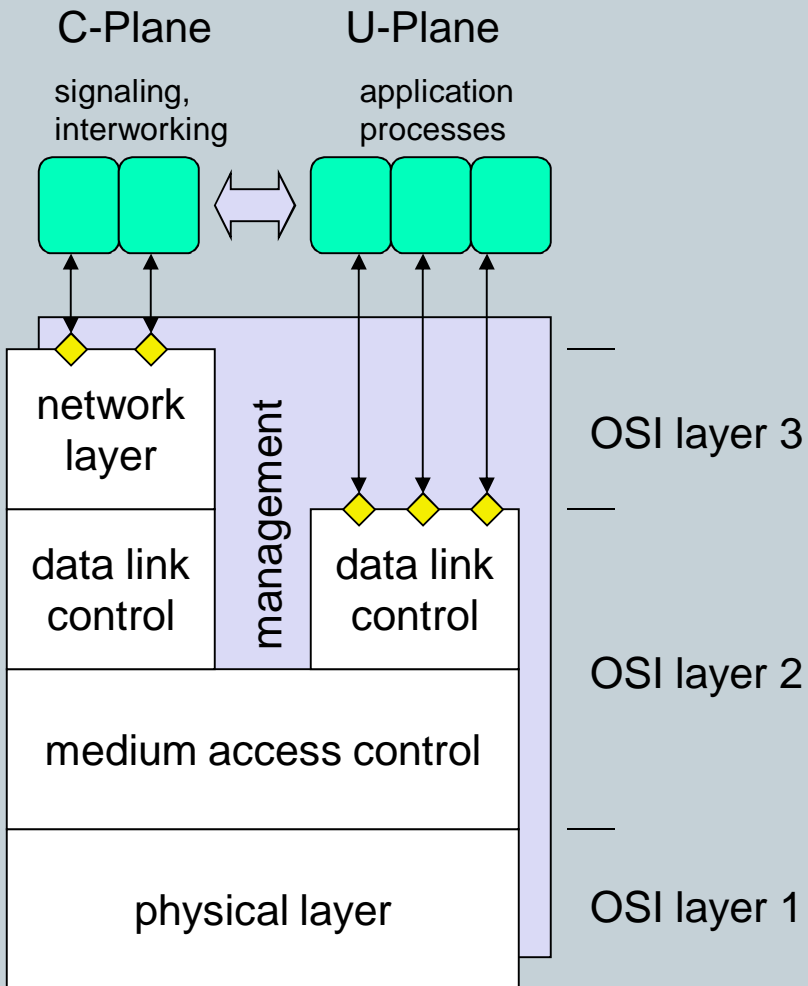


- DECT (Digital European Cordless Telephone) standardized by ETSI (ETS 300.175-x) for cordless telephones
- standard describes air interface between base-station and mobile phone
- DECT has been renamed for international marketing reasons into „Digital Enhanced Cordless Telecommunication“
- Characteristics
 - frequency: 1880-1990 MHz
 - channels: 120 full duplex
 - duplex mechanism: TDD (Time Division Duplex) with 10 ms frame length
 - multiplexing scheme: FDMA with 10 carrier frequencies, TDMA with 2x 12 slots
 - modulation: digital, Gaussian Minimum Shift Key (GMSK)
 - power: 10 mW average (max. 250 mW)
 - range: approx. 50 m in buildings, 300 m open space

DECT system architecture reference model



DECT reference model



- close to the OSI reference model
- management plane over all layers
- several services in C(ontrol)- and U(ser)-plane

DECT layers I



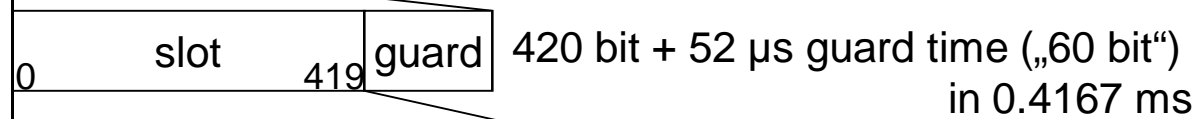
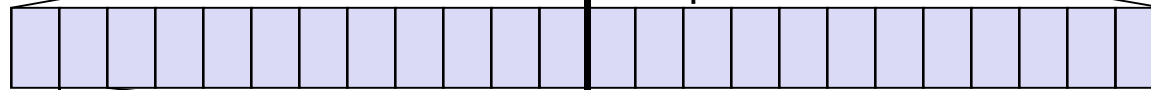
- **Physical layer**
 - modulation/demodulation
 - generation of the physical channel structure with a guaranteed throughput
 - controlling of radio transmission
 - ✦ channel assignment on request of the MAC layer
 - ✦ detection of incoming signals
 - ✦ sender/receiver synchronization
 - ✦ collecting status information for the management plane
- **MAC layer**
 - maintaining basic services, activating/deactivating physical channels
 - multiplexing of logical channels
 - ✦ e.g., C: signaling, I: user data, P: paging, Q: broadcast
 - segmentation/reassembly
 - error control/error correction

DECT time multiplex frame

1 frame = 10 ms



12 down slots | 12 up slots



A: network control

B: user data

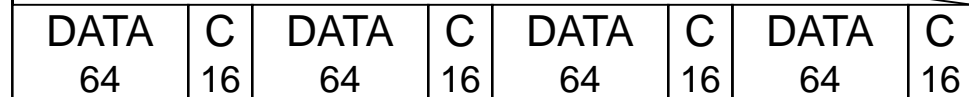
X: transmission quality

25.6 kbit/s
simplex bearer

32 kbit/s

protected
mode

unprotected
mode



DECT layers II



- Data link control layer
 - creation and keeping up reliable connections between the mobile terminal and basestation
 - two DLC protocols for the control plane (C-Plane)
 - ✦ connectionless broadcast service: paging functionality
 - ✦ Lc+LAPC protocol: in-call signaling (similar to LAPD within ISDN), adapted to the underlying MAC service
 - several services specified for the user plane (U-Plane)
 - ✦ null-service: offers unmodified MAC services
 - ✦ frame relay: simple packet transmission
 - ✦ frame switching: time-bounded packet transmission
 - ✦ error correcting transmission: uses FEC, for delay critical, time-bounded services
 - ✦ bandwidth adaptive transmission
 - ✦ “Escape” service: for further enhancements of the standard

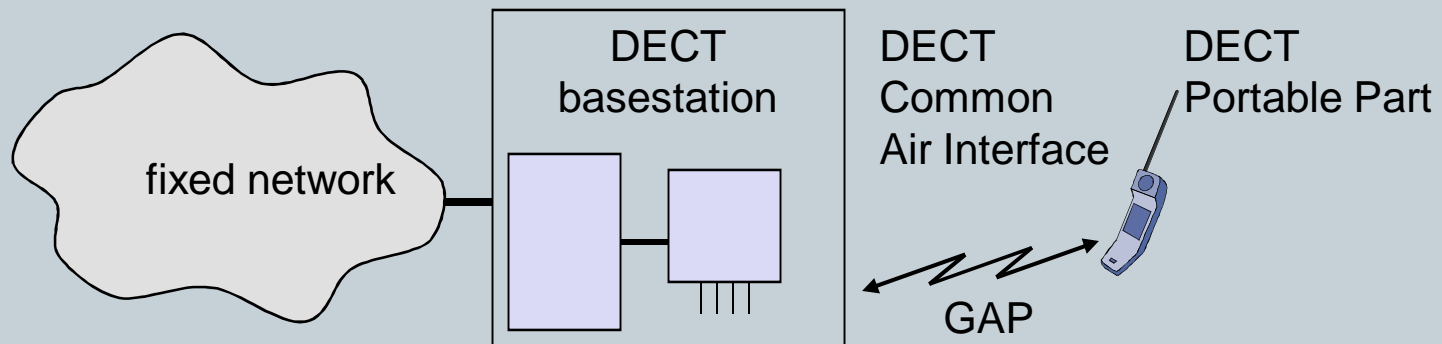
DECT layers III



- Network layer
 - similar to ISDN (Q.931) and GSM (04.08)
 - offers services to request, check, reserve, control, and release resources at the basestation and mobile terminal
 - resources
 - ✦ necessary for a wireless connection
 - ✦ necessary for the connection of the DECT system to the fixed network
 - main tasks
 - ✦ call control: setup, release, negotiation, control
 - ✦ call independent services: call forwarding, accounting, call redirecting
 - ✦ mobility management: identity management, authentication, management of the location register

Enhancements of the standard

- Several „DECT Application Profiles“ in addition to the DECT specification
 - GAP (Generic Access Profile) standardized by ETSI in 1997
 - ✦ assures interoperability between DECT equipment of different manufacturers (minimal requirements for voice communication)
 - ✦ enhanced management capabilities through the fixed network: Cordless Terminal Mobility (CTM)



- DECT/GSM Interworking Profile (GIP): connection to GSM
- ISDN Interworking Profiles (IAP, IIP): connection to ISDN
- Radio Local Loop Access Profile (RAP): public telephone service
- CTM Access Profile (CAP): support for user mobility

TETRA - Terrestrial Trunked Radio

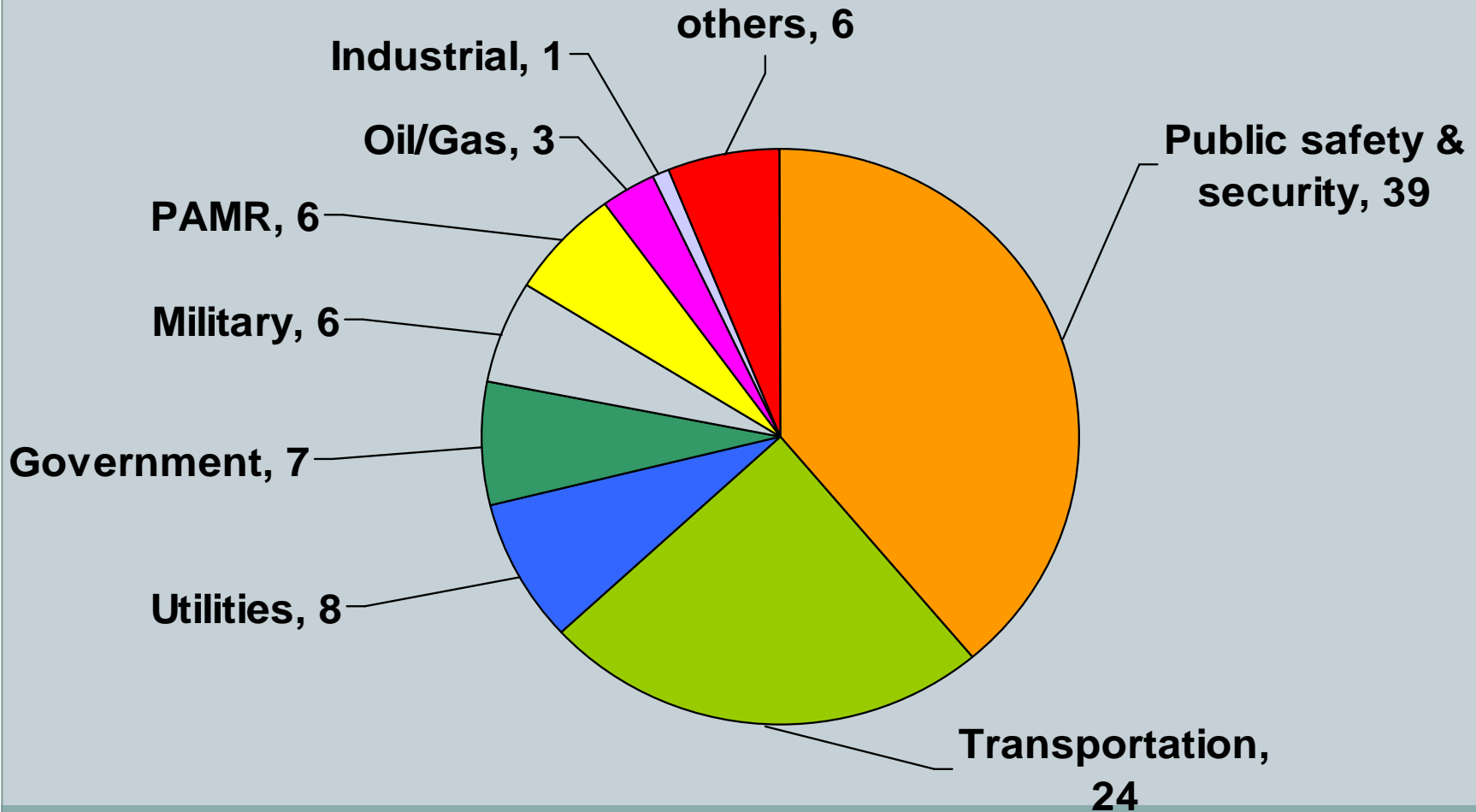


- Trunked radio systems
 - many different radio carriers
 - assign single carrier for a short period to one user/group of users
 - taxi service, fleet management, rescue teams
 - interfaces to public networks, voice and data services
 - very reliable, fast call setup, local operation
- TETRA - ETSI standard
 - formerly: Trans European Trunked Radio
 - point-to-point and point-to-multipoint
 - encryption (end-to-end, air interface), authentication of devices, users and networks
 - group call, broadcast, sub-second group-call setup
 - ad-hoc ("direct mode"), relay and infrastructure networks
 - call queuing with pre-emptive priorities

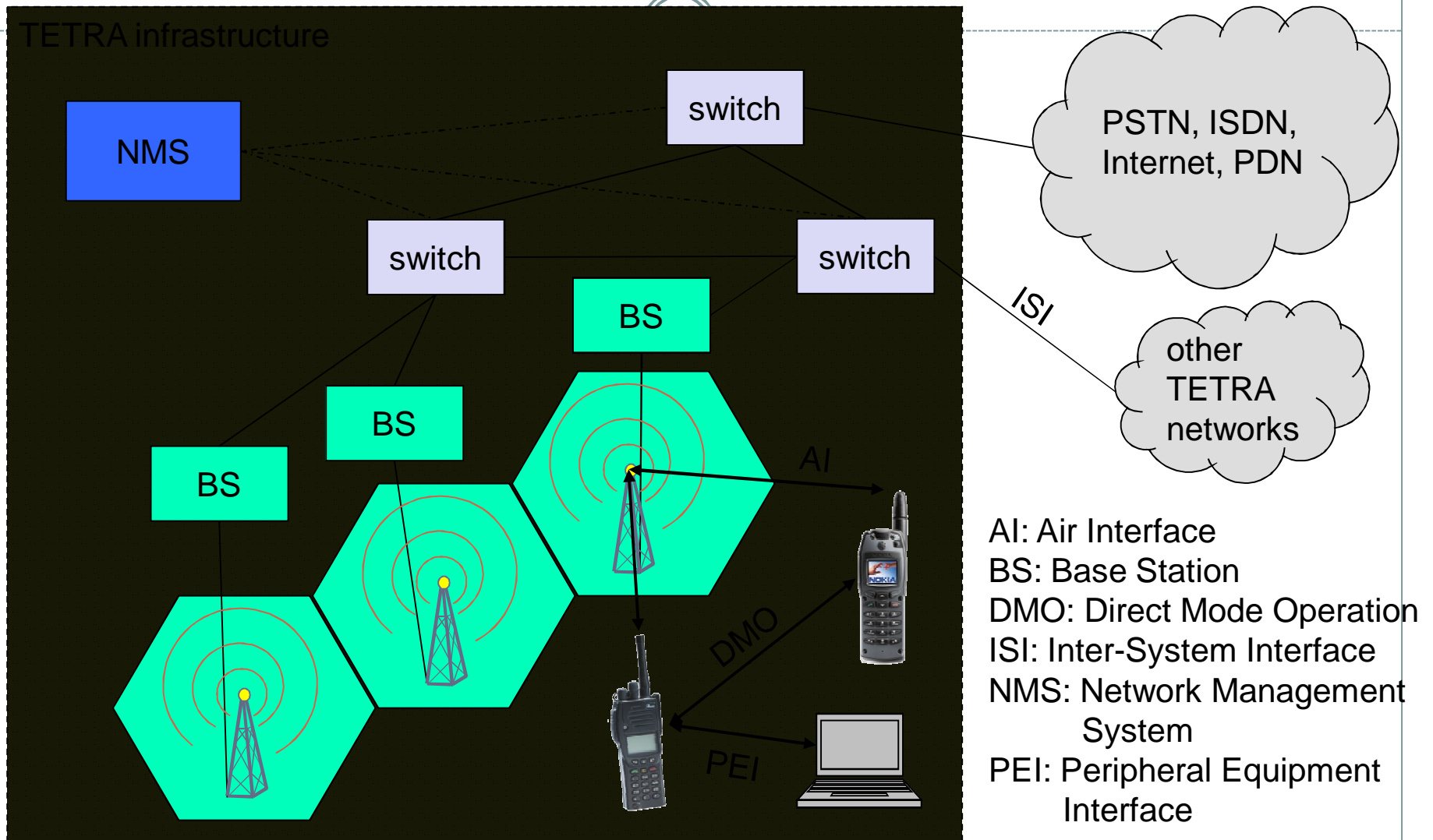
TETRA – Contracts by Sector (percentage)



Used in over 70 countries, more than 20 device manufacturers



TETRA – Network Architecture



TETRA – Direct Mode I

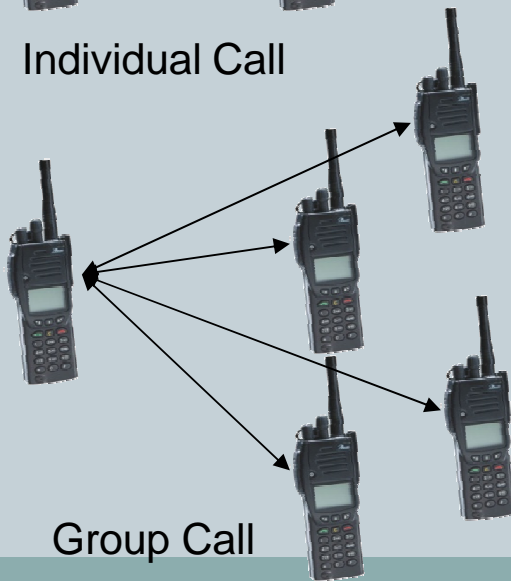
- Direct Mode enables ad-hoc operation and is one of the most important differences to pure infrastructure-based networks such as GSM, cdma2000 or UMTS.



Individual Call



“Dual Watch” – alternating participation in Infrastructure and ad-hoc



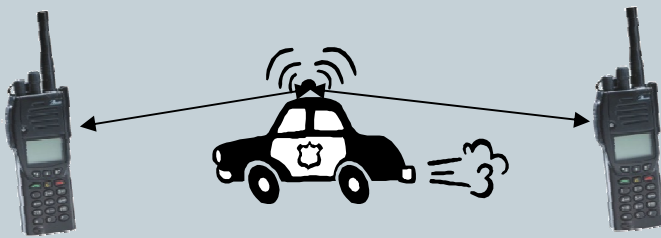
Group Call



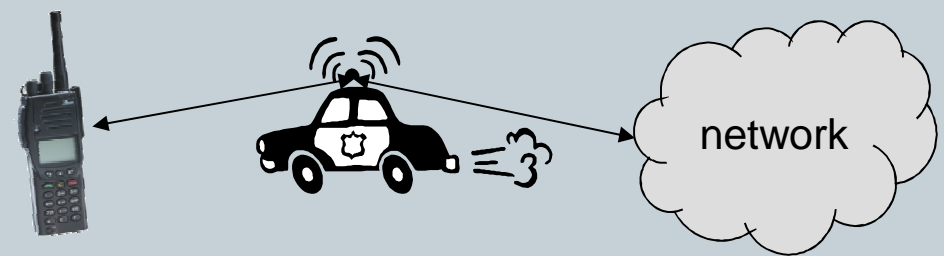
Managed Direct Mode

TETRA – Direct Mode II

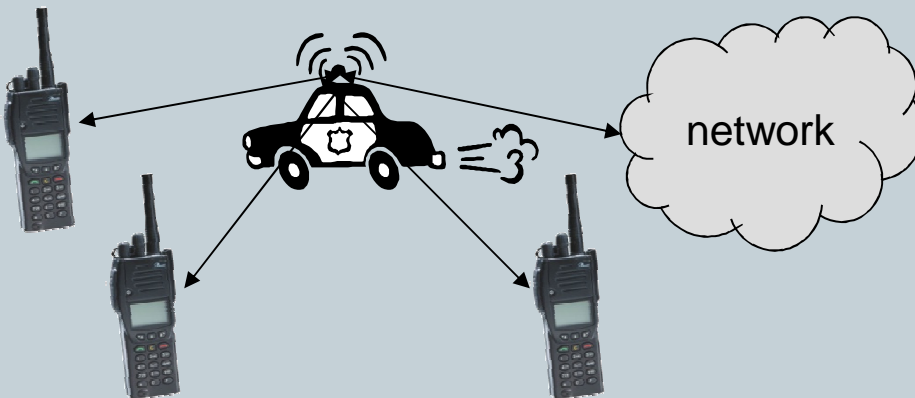
- An additional repeater may increase the transmission range (e.g. police car)



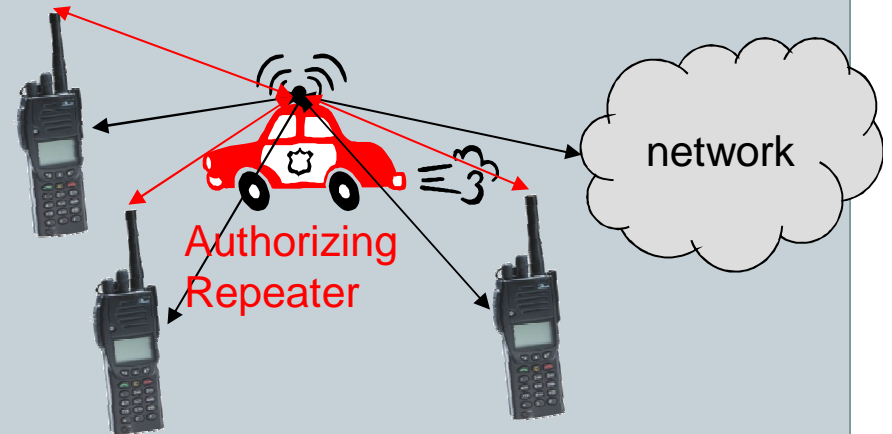
Direct Mode with Repeater



Direct Mode with Gateway



Direct Mode with Repeater/Gateway



Managed Repeater/Gateway

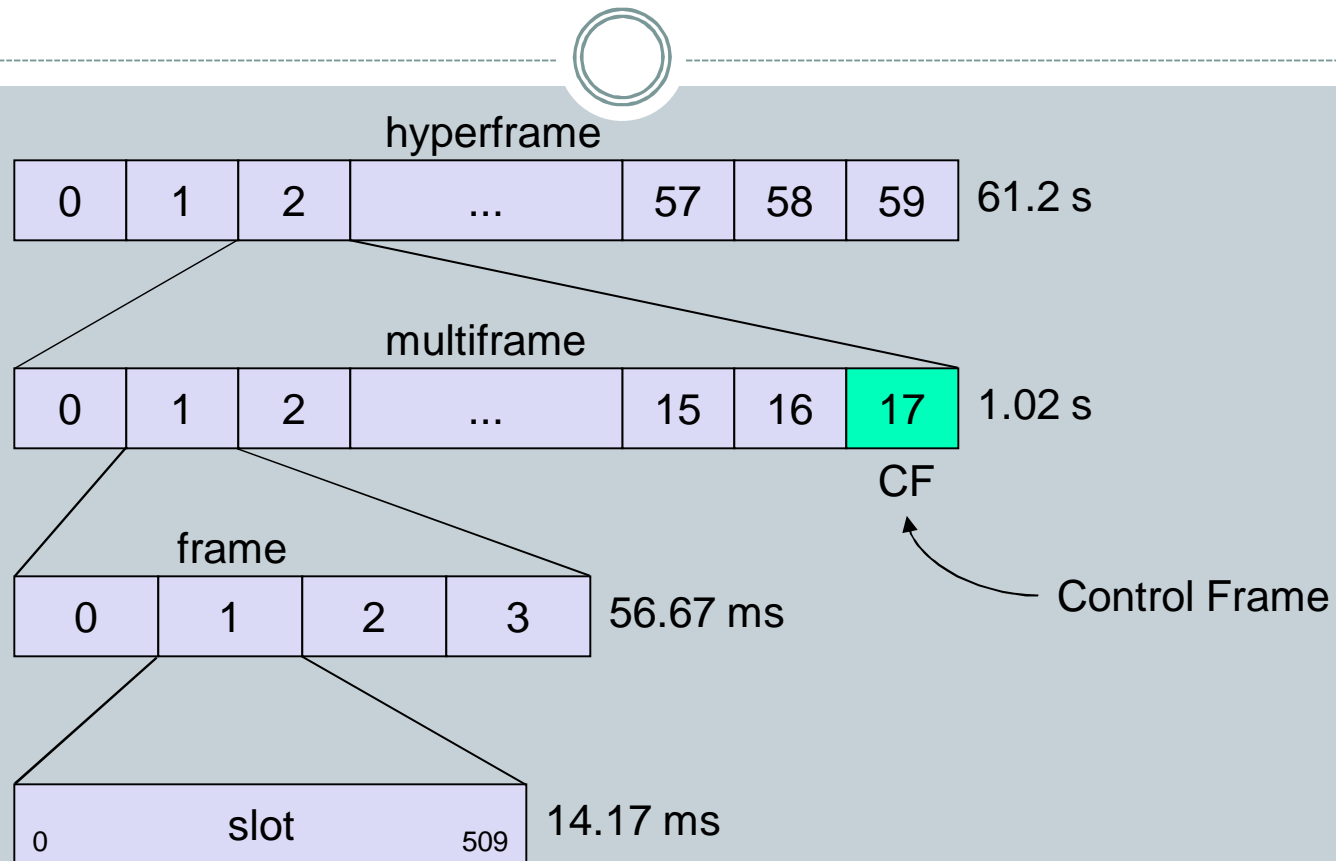
TETRA – Technology



- Services
 - Voice+Data (V+D) and Packet Data Optimized (PDO)
 - Short data service (SDS)

- Frequencies
 - Duplex: FDD, Modulation: DQPSK
 - Europe (in MHz, not all available yet)
 - ✦ 380-390 UL / 390-400 DL; 410-420 UL / 420-430 DL, 450-460 UL / 460-470 DL; 870-876 UL / 915-921 DL
 - Other countries
 - ✦ 380-390 UL / 390-400 DL; 410-420 UL / 420-430 DL, 806-821 UL / 851-866 DL

TDMA structure of the voice+data system



TETRA – Data Rates



- Infrastructure mode, V+D in kbit/s

• No. of time slots	1	2	3	4
• No protection	7.2	14.4	21.6	28.8
• Low protection	4.8	9.6	14.4	19.2
• High protection	2.4	4.8	7.2	9.6

- TETRA Release 2 – Supporting higher data rates
 - TEDS (TETRA Enhanced Data Service)
 - up to 100-500 kbit/s
 - ✦ depends on modulation (DQPSK, D8PSK, 4/16/64QAM) and channel width (25/50/100/150 kHz)
 - backward compatibility