

Risks of Mobile Phones

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Agenda

- History
- Base Stations And Mobile Phones
- Setting Up A Connection
- Wave Propagation
- Risks For The Human Brain
- Discussion

Evolution of Telecommunication - I

- electric impulses transmitted by Samuel Morse (1837)
- first **telephone** by Philipp Reis (1861)
 - just noises
 - voice transmission by Graham Bell (1876)
- mobile networks in Germany:
 - A-network (1958)
 - **analogue** technology
 - B-network (1972)
 - moving while phoning possible
 - C-network (1986)
 - last analogue network in Germany
 - **commercial breakthrough** of mobile phones



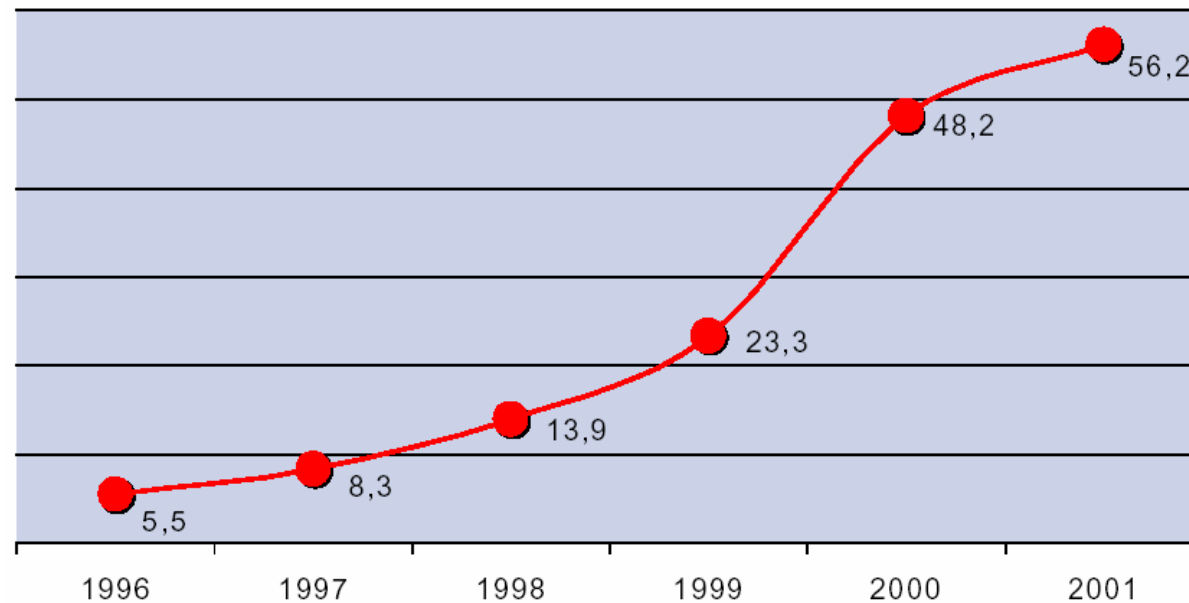
Evolution of Telecommunication - II

- mobile networks in Germany (continued):
 - D- & E-networks (1992)
 - digital GSM technology
 - GSM: Global System for Mobile communications
 - high availability and reliability
 - standardized worldwide → available in huge parts of Asia, South America and Australia
 - UMTS (2002)
 - Universal Mobile Telecommunications System
 - multimedia services
 - expensive licenses: >100 billion €



Widespread Use of Mobile Phones

- skyrocketing numbers in just ~5 years
 - more than **1 billion mobile phones** worldwide
 - about **70%** of all Germans own at least one
 - saturation effects



Exemplary Mobile Phones



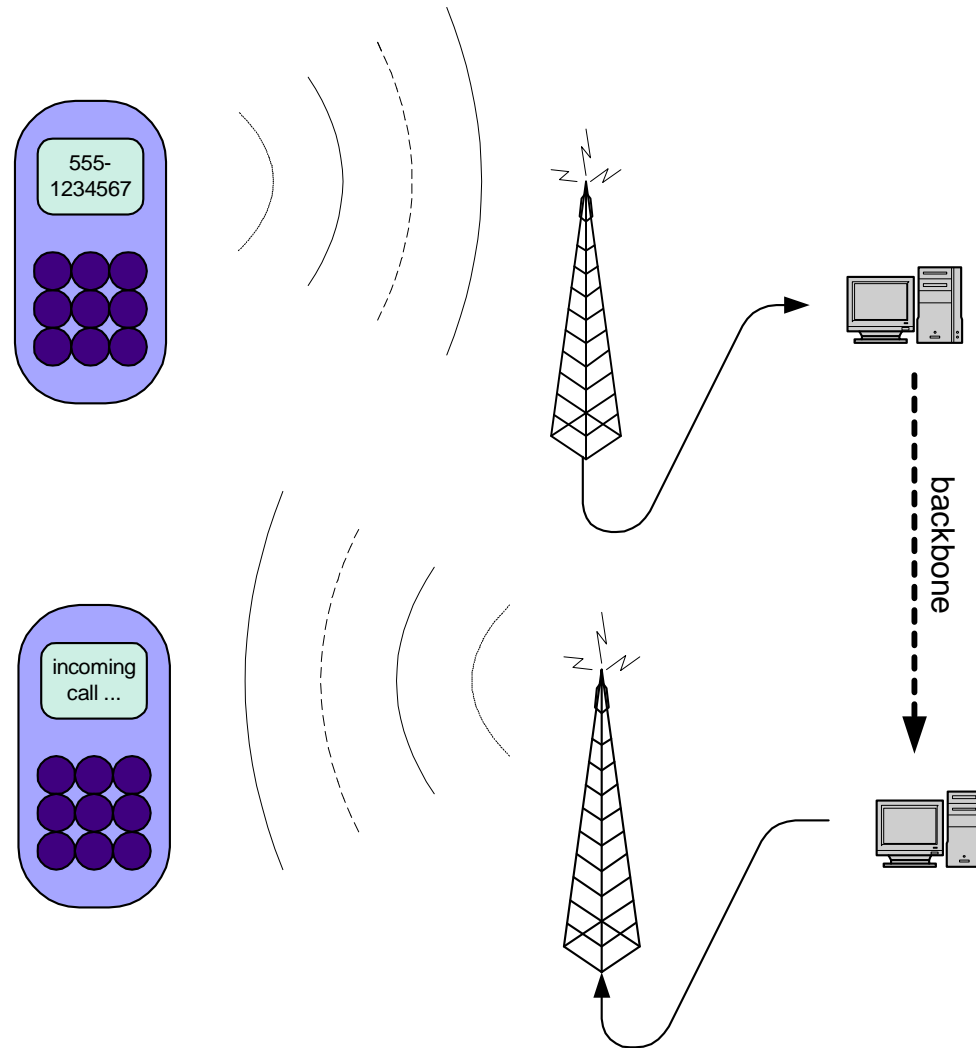
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Exemplary Base Stations



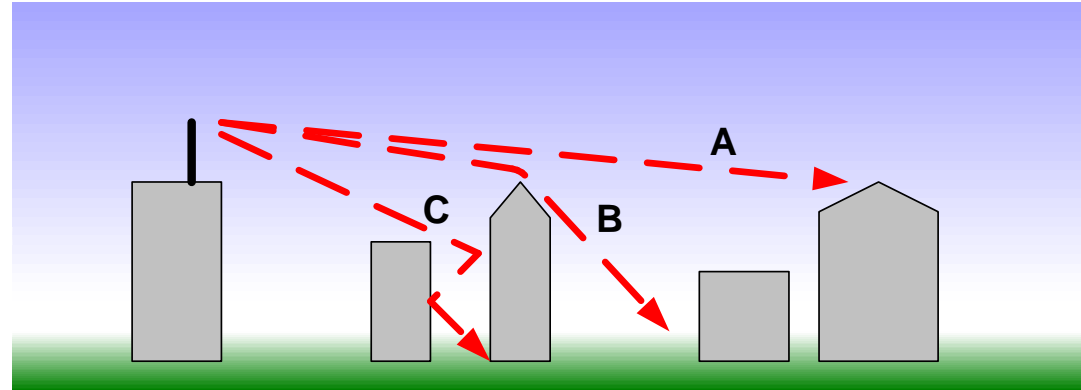
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Setting Up a Connection



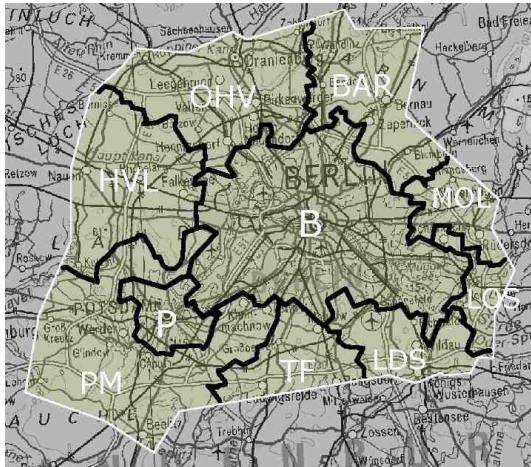
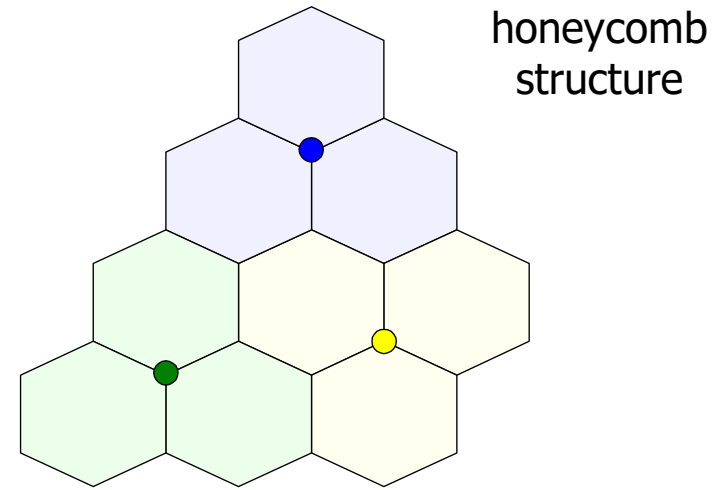
Wave Propagation

- line-of-sight
- no-line-of-sight
 - diffraction
 - reflection



Achieving High Coverage

- each **base station (BTS)** ...
 - consists of 1 to 6 antennas, often 3
 - each **antenna** covers one **cell**
 - a single cell varies in size from 100 m to 30 km



Berlin and its surrounding area

May 31, 2002:

D1: 503 BTS, 1353 cells

D2: 622 BTS, 1594 cells

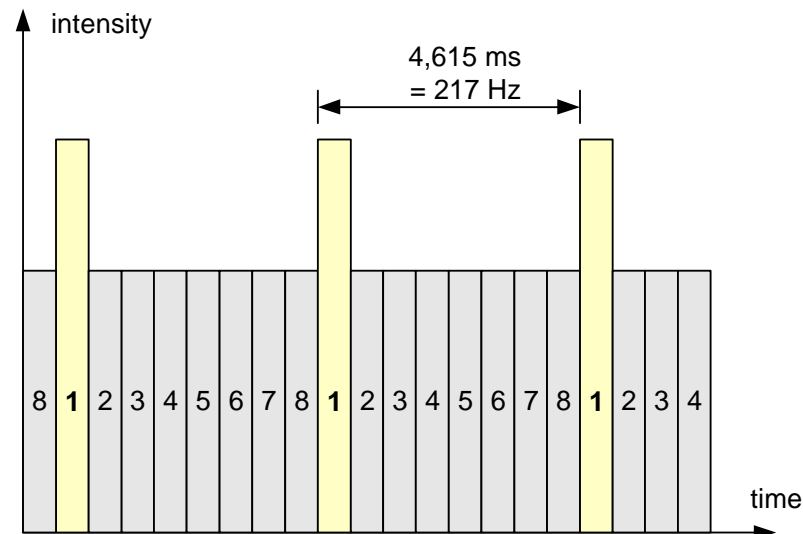
E+: 338 BTS, 978 cells

O2: 361 BTS, 1036 cells

Σ 1824 BTS, 4961 cells

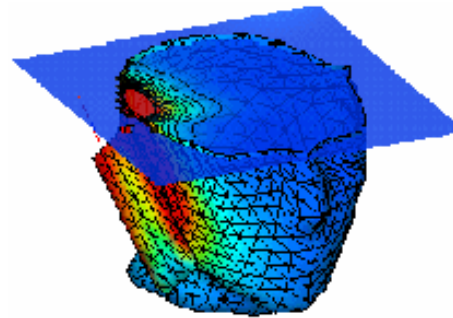
Pulsed Waves

- multiple mobile phones **share** the same frequency
 - usually 8 phones
- time is **slotted**
 - 4.615 ms/slot \rightarrow 217 Hz
 - can be heard if amplified by a loudspeaker



Emissions of Mobile Phones

- a mobile phone emits up to 2 W depending on
 - the **distance** to the next base station
 - **interferences**
 - absorbing **buildings**

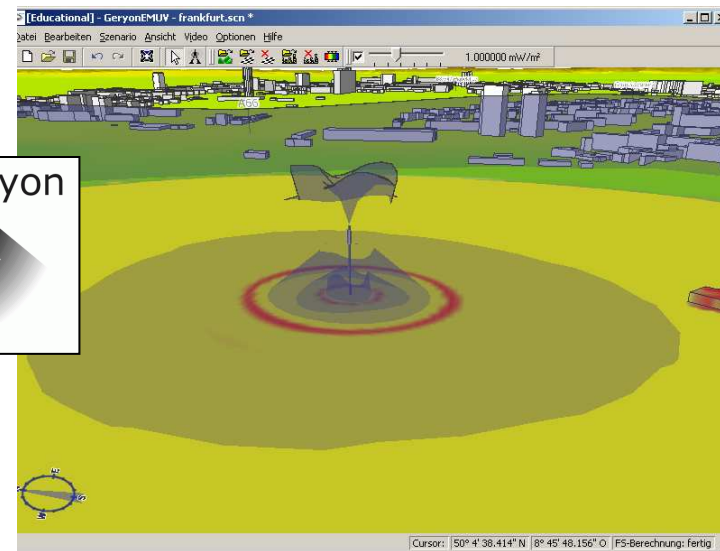
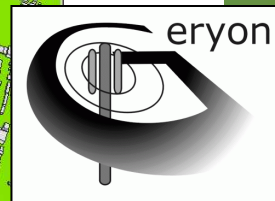
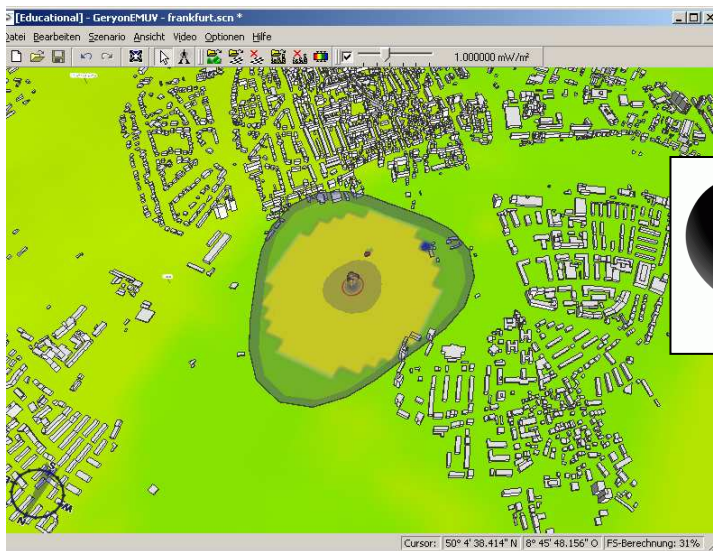
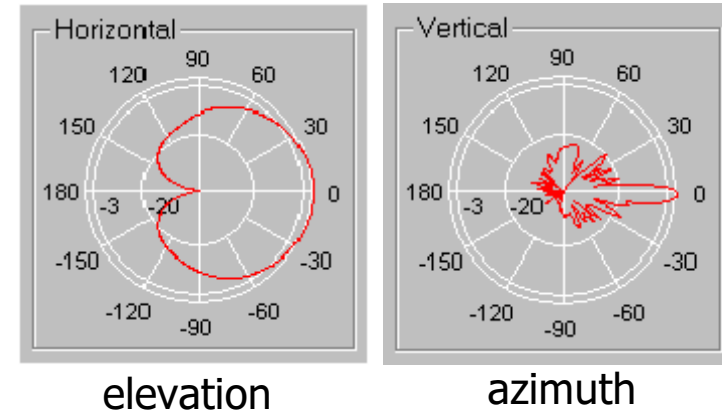


- induces **heat** in the body
 - $1/8 * 2 \text{ W} \approx 0.25 \text{ W}$
 - human body itself emits 100 W
 - penetrates the brain up to **9 cm**
 - may interfere with **brain waves**, especially **children's**
 - sensitive people notice tiredness, stress



Emissions of Base Stations

- more than 100 types
 - broad range of size and techniques
- power consumption
 - 15 to 50 W, average: 28 W
 - directed
 - main direction up to 700 W



Upper Limits Defined by Laws

- Germany
 - according to 26th BImSchV
 - 4.5 W/m² (900 MHz, D-networks),
9.0 W/m² (1800 MHz, E-networks)
- Italy, China, Russia
 - 0.1 W/m²
- Salzburg (Austria)
 - 0.001 W/m²

Proved Diseases

- not yet !
 - no statistical evidences found
 - Denmark: **cancer reduced** by approx. 20% after introducing mobile phones
- more than 20,000 studies
 - some maldeveloped brains of cows observed
 - shortened life of rats
 - but **extraordinary high exposure** to pulsed waves
- more a **psychological** problem
 - anxiety

Questions



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