

Mobile Communications

Problem Set 11

Prof. Dr.-Ing. Markus Fidler
M.Sc. Felix Langenbruch

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Institut für
Kommunikations-
Technik



1. Explain the difference between physical and logical channels. What are the two groups of logical channels in GSM?

Solution:

- **physical channels:** TDM channel, one slot every 4.615 ms
- **logical channels:** are mapped onto physical channels, e.g. using TDM

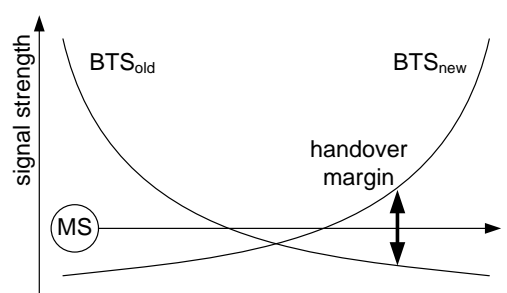
Two groups of logical channels

- **traffic channels (TCH):** used to transmit user data
 - full-rate TCH (TCH/F): 22.8 kb/s
 - * full rate (FR) voice: 13 kb/s + error correction code
 - half-rate TCH (TCH/H): 11.4 kb/s
 - * half rate (HR) voice: 5.6 kb/s + error correction code
- **control channels (CCH):** used to transmit control data

2. Explain the term handover margin.

Solution:

- MS measures signal strength of its and neighboring BTSs
- measurements are taken periodically every 0.5 s
- measurements are sent to the BSC for handover decision
- averaging to compensate for short-term fluctuations
- handover margin uses hysteresis to avoid oscillations (important!)



3. What is the purpose of the A3 Algorithm? Where is it implemented and executed?

Solution:

- The A3 algorithm is used for the authentication of the mobile device
- It is implemented and executed in the authentication center (AUC) and in the mobile station (SIM)

4. Why is GPRS more suitable for transmitting WWW traffic than HSCSD?

Solution:

High Speed Circuit Switched Data (HSCSD) wastes large amounts of scarce radio resources. It is useful for continuous constant bit rate media streams or large file up/downloads. But it is not useful for variable bit rate streams or typical WWW traffic that is sporadic and bursty.

GPRS has a fully packet oriented architecture that is more efficient service for Internet applications. It achieves an 'always connected' characteristic.

5. Is cell breathing a problem for (a) GSM (b) UMTS (c) LTE ?

Solution:

Cell breathing occurs in CDMA systems as the increase in the number of users leads to (1) a decrease of the cell range (2) an increase in the noise power level in the cell. This is only the case in UMTS as it is the only system from the 3 systems noted above that uses CDMA. Further, users at the border of the cell have weak signals that may be drowned in noise so that they cannot communicate.

6. The evolution of mobile / cellular communication systems is given by certain technologies that increase the data rate. Name 4 examples.

Solution:

- higher signal power
 - but causes also higher interference
- wider bandwidth
 - OFDM to mitigate ISI
- MIMO antennas
 - antenna diversity (combining)
 - beam forming
(less interference)
 - spatial multiplex
- higher order modulation

- Shannon's law

$$C = B \log_2 \left(1 + \frac{S}{N} \right)$$

- S/N = signal-to-noise ratio
- B = bandwidth [Hz]
- C = max data rate [b/s]

modulation	symbols	bits/symbol
BPSK	2	1
QPSK	4	2
16QAM	16	4
64QAM	64	6