Aalto University
Comnet

S-72.3216 Radio Communication Systems II P (5 cr)

Exam (10th January, 2012)

Problem 1. *(General concepts within WCDMA and HSPA technologies)*

Explain the following procedures/functions in WCDMA/HSPA context:

(a) Soft handover, softer handover, hard handover.

(b) Admission control, congestion control.

(c) Fast power control, outer loop power control. What entities in WCDMA network are managing these procedures?

Problem 2.

Are the following statements right or wrong? Answer just T/F (i.e., True or False). No justification of the chosen alternative is required.

(a) In WCDMA downlink spreading codes are used to separate user transmissions from each other.

(b) In WCDMA uplink capacity is bounded due to limited number of spreading codes.

(c) The HSDPA open-loop transmit-diversity method provides both, diversity gain and coherent combining gain.

(d) In HSDPA the so-called Round Robin (RR) scheduling utilizes the channel information that is signalled from user equipment.

(e) In both LTE and LTE-Advanced, the number of *spatial multiplexing* (SM) *multiple-input multiple-output* (MIMO) data streams in uplink can be four.

(f) The SC-FDMA receiver implementation is usually less complex than OFDMA receiver implementation.

(g) In LTE the number of SM-MIMO data streams can be four in downlink, while in LTE-Advanced it can be up to eight.

(h) Multiuser MIMO (MU-MIMO) is not supported by LTE, but it is supported by LTE-Advanced.

Evaluation criterion:

8 correct answers $\rightarrow$ 6 points, 7 correct answers $\rightarrow$ 5 points,
6 correct answers $\rightarrow$ 4 points, 5 correct answers $\rightarrow$ 3 points,
4 correct answers $\rightarrow$ 2 points, 3 correct answers $\rightarrow$ 1 points,
less than 3 correct answers $\rightarrow$ 0 points.

Problem 3. *Concept of Link budget*

(a) Define the processing gain and spreading gain for WCDMA. Give some typical values for processing gain and spreading gain. Justify your values shortly.

(b) Define the interference margin in HSDPA link budget. Give some typical values for the interference margin. Justify your values shortly.

(c) What is the fast fading margin and why it is used in WCDMA uplink link budget?

(d) Why there is soft handover gain in WCDMA link budget but not in HSDPA link budget?

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Problem 4. *(HSPA and LTE concepts)*

(a) Describe the High Speed Downlink Shared Channel (HS-DSCH) concept of HSDPA and explain how it differs from the Dedicated Channel (DCH) concept of WCDMA. Why HS-DSCH is more effective when Fast Scheduling (sometimes also called as Channel dependent scheduling or Channel aware scheduling) is used.

(b) What are the main differences between WCDMA uplink and HSUPA?

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Problem 5. *(LTE-Advanced concepts)*

Answer briefly to the following questions:

(a) *Coordinated multipoint* (CoMP) transmission: Describe *joint processing* and *coordinated scheduling/beamforming*. What is the main difference between both techniques?

(b) *Carrier aggregation* (CA): Describe *intra-band aggregation* with contiguous carriers, *intra-band aggregation* with non-contiguous carriers, and *inter-band aggregation*. Which case is simpler to implement in practice? Justify your answer in a simple, but clear way.

(c) Relaying: Describe *in-band relaying* and *out-band relaying*. What are the main differences between both types of relaying approaches?

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Some Abbreviations

HS-DSCH = High Speed Downlink Shared Channel,
MU = Multi-User,
MIMO = Multiple-Input Multiple-Output,
P-CPICH = Primary Common Pilot Channel,
SM = Spatial Multiplexing,
UTRAN = Universal Terrestrial Radio Access Network.