Radio Communication Systems II, Examination, 17.2.2014

Problem 1.

a) Describe briefly WCDMA soft hand over, softer handover and hard handover. What are the differences between these handovers? Why soft and softer handover are used in WCDMA?
b) Why Random Access Procedure is used in mobile networks? Explain briefly how WCDMA Random Access Procedure is executed.

Problem 2.

HSPA link budget: Fill missing values related to A-F for 512 kbps service on HS-DSCH. Give results in answer paper and explain how the values were calculated.

		HS-DSCH 512kbps	
	Transmitter characteristics		
	Transmitter power on HS_DSCH	10,00	W
A	Transmitter power on HS_DSCH		dBm
	TX antenna gain	17,40	dBi
	TX cable loss	2,00	dB
B	**Transmitter EIRP**		**dBm**
	Receiver characteristics		
	Thermal noise density	-173,98	dBm/Hz
	Receiver noise figure	8,00	dB
	Receiver noise density	-165,98	dBm/Hz
	Receiver noise power	-100,13	dBm
C	Spreading gain		dB
	SINR	5,00	dB
D	Receiver sensitivity		dB
	Load factor	0,80	
E	Interference margin		dB
	RX antenna gain	3,00	dBi
	RX Body loss	0,00	dB
	Diversity gain	0,00	dB
	Fast fading margin	0,00	dB
	Soft handover gain	0,00	dB
	Indoor penetration loss	20,00	dB
	Shadow Fading Margin	8,00	dB
F	**Allowed propagation loss**		**dB**

Problem 3. LTE and HSPA: Are the following statements right or wrong? Answer just T/F (True/False).

1) In LTE downlink the user data rate depends on the number of physical resource blocks that are allocated to the user.
2) In LTE the accuracy of the time synchronization is more important than the accuracy of the frequency synchronization.
3) In LTE the Mobile Management Entity (MME) is tracking the location (on cell or Tracking Area level) of all User Equipments (UE's) in the network.
4) In LTE the control information between eNodeB (evolved Node B) and MME is carried through the so-called X2 interface.
5) In LTE uplink the user bandwidth is doubled if user data rate is doubled when modulation and coding scheme is kept fixed.
6) In HSDPA only 2x2 MIMO (Multiple Input Multiple Output) is supported. Thus, there can be up to two separate data streams.
7) The HSDPA closed-loop transmit diversity method needs two orthogonal P-CPICH (Primary Common Pilot Channel) for channel estimation.
8) The HSDPA open-loop transmit diversity method provides both diversity and coherent combining gain.

(Evaluation: 7 correct answers => 6 points, 6 correct answers => 5 points, 5 correct answers => 4 points, 4 correct answers => 3 points, 3 correct answers => 2 points, 2 correct answers => 1 point, less than 2 correct answers => 0 points)

Problem 4. Describe briefly the following concepts

a) Hybrid Automatic Repeat reQuest (HARQ). Why so-called Stop-And-Wait structure is used in HARQ?
b) Fast scheduling. Why fast scheduling is more effective in LTE than in HSPA? What are the main algorithmic approaches used in fast scheduling?
c) Admission and congestion control. Why admission and congestion control are used in mobile networks?

Problem 5. In Figure 1 the LTE link spectral efficiency is given as a function of Signal to Interference and Noise ratio. The curve with crosses (x) is related to 2x2 MIMO transmission while curve marked by circles (o) is related to 4x4 MIMO transmission. The LTE bandwidths and number of resource blocks for different band options are given in Table 1.

a) Using Figure 1 define what is the maximum data rate (in bits/s) for 2x2 and 4x4 MIMO in 3MHz and 10MHz deployments.
b) User with 5 RBs and 4x4 MIMO is served. What is the minimum required SINR when user data rate should be at least 10Mbit/s?
c) Scheduler allocates for the user 3 RBs. What is the data rate of the user with 4x4 MIMO if SINR=12.5dB. How much rate is decreased if 2x2 MIMO is used instead of 4x4 MIMO?

Bandwidth	1.4MHz	3MHz	5MHz	10MHz	20MHz
Total bandwidth for RBs	1.08MHz	2.7MHz	4.5MHz	9MHz	18MHz
Resource Blocks (RBs)	6	15	25	50	100

Table 1.

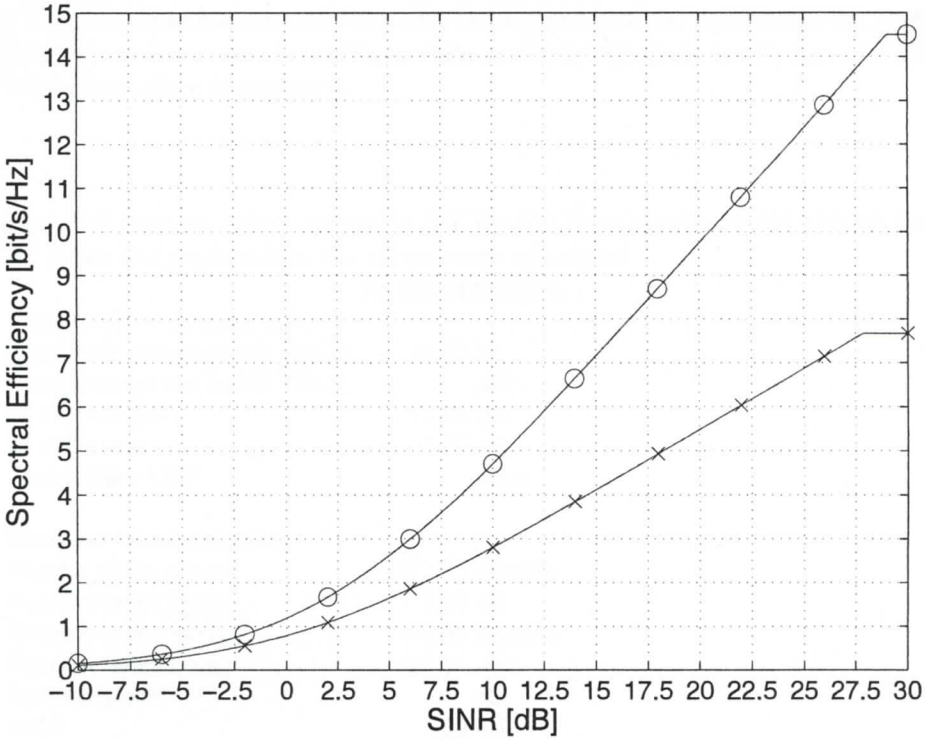

Figure 1. Spectral efficiency versus SINR for 2x2 and 4x4 MIMO