

Radio Communication Systems II, Examination, 16.12.2010

**Problem 1.**

- a) Describe what concept 'open interface' in UTRAN architecture means. Why open interfaces are introduced?
- b) Describe the principle of WCDMA RAKE receiver.
- c) Describe the principle of WCDMA Random Access Channel (RACH) procedure.

**Problem 2.** Calculate the allowed propagation loss for WCDMA 12.2 kbps speech service. It is assumed that control overhead is 15%, maximum number of speech users is 65 and WCDMA chip rate is 3.84Mcips/s. Give the missing figures related to A-G in your answer and explain how the values were calculated.

		12.2kbps voice, DL
Target load		0,75
Transmitter characteristics	Total transmitter power	20 W
	Transmitter power on TCH	W
A		
B		dBm
	TX antenna gain	17,4 dBi
	TX cable loss	0 dB
	TX Body loss	0 dB
C	<b>Transmitter EIRP</b>	dBm
Receiver characteristics and margins	RX antenna gain	0 dBi
	Thermal noise density	-174 dBm/Hz
	Receiver noise figure	8 dB
	Receiver noise density	-166 dBm/Hz
	Receiver noise power	-100,157 dBm
D	Processing gain	dB
	Required Eb/No	7 dB
E	Interference margin	dB
F	Required signal power	dBm
	RX Cable loss	0 dB
	RX Body loss	2 dB
	Diversity gain	0 dB
	Fast fading margin	0 dB
	Soft handover gain	1 dB
	Coverage probability (cell edge)	0,9
	Shadow fading std deviation	6 dB
	Shadow Fading Margin	0 dB
	Indoor penetration loss	20 dB
G	<b>Allowed propagation loss</b>	dB

**Problem 3.**

- a) Describe three features that are different in HSDPA High Speed Downlink Shared Channel (HS-DSCH) and WCDMA Dedicated Channel (DCH).
- b) Briefly explain the principle of HSUPA scheduling and the differences between uplink and downlink scheduling in HSPA. Why LTE scheduling is more efficient than HSDPA scheduling?
- c) Briefly explain the principle of Hybrid Automatic Repeat Request (HARQ) protocol. Describe two main HARQ algorithms and explain what is the Stop And Wait (SAW) structure for HARQ? You are encouraged to use illustrations in your answer.

**Problem 4. Multi-antenna methods in WCDMA/HSDPA:**

- a) Describe the principles of different multi-antenna methods that can be used in WCDMA/HSDPA (4 different methods).
- b) Related to each method, explain why it improves the downlink performance.
- c) Are there limitations on the number of applied base station antennas for different methods? What is/are reason(s) for such limitation(s)?

**Problem 5. LTE concepts/functions**

- a) Describe main functions of LTE Mobility Management Entity (MME).
- b) Name and briefly describe LTE uplink and downlink multiple access methods. What are differences between these methods and why different multiple access methods were selected for uplink and downlink?
- c) Describe the main functions of LTE Radio Resource Management.