

**MUC**  
**Winter 2015**  
**Final Exam**  
**27/1/2016**  
**Time Limit: 120 Minutes**

**Name:** \_\_\_\_\_

By signing my name above,  
I agree to the University of Ljubljana  
academic honesty policies.

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This exam contains 1 page and 5 questions.  
Total of points is 50.

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1. (10 points) Background processing.
  - (a) (4 points) Explain why background processing is important in mobile computing (in particular for mobile sensing).
  - (b) (6 points) Name two different approaches to implementing concurrency in Android and briefly describe them. (note: there exist more than two, so just pick the two you are the most familiar with)
2. (10 points) In applications that use background sensing we often have to ensure that sensor sampling does not drain a device's battery. Two main approaches for increasing energy efficiency are *adaptive duty cycling* and *hierarchical sensor activation*.
  - (a) (5 points) Describe adaptive duty cycling.
  - (b) (5 points) Describe hierarchical sensor activation.
3. (10 points) Fading in wireless transmission.
  - (a) (5 points) Explain what is meant by the terms "fading" and "multi-path", and how these phenomena relate to each other.
  - (b) (5 points) Explain the difference between "small-scale fading" and "large-scale fading" (shadowing).
4. (10 points) Consider two wireless nodes placed in free space (no obstacles, no reflections, no multi-path). During a calibration test, node A is set to transmit with power  $P_{T,test}$  at the carrier frequency  $f_{c,test} = 5.8$  GHz. Node B, placed at distance  $d_{test} = 35$  m from node A, is receiving the signal with power  $P_{R,test} = -64$  dBm. Assuming that the receiver sensitivity of node B is  $P_{R,min} = -87$  dBm, calculate the maximum theoretical reception range  $d_{max}$  that can be reached in operational conditions if the transmit power is doubled  $P_{T,op.} = 2 \cdot P_{T,test}$  and the carrier frequency is reduced to  $f_{c,op.} = 2.45$  GHz.
5. (10 points) Assume you have the task of measuring the number of daily commuters between two different cities from network-based data. In particular, you want to assess whether there is any significant difference between migrations during working days and weekends. Discuss the relative advantages and disadvantages of using CDR vs. VLR. If you have the option of using either CDR or VLR, but not both, explain the factors that would influence your decision between the two.