# Mobile Communication
# Summer term 2016
## Practical Assignment Sheet # 1

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- Release date: **April 11, 2016**
- The practical assignment sheet must be solved in groups of two, and you must register your group beforehand. Registration process:
  - **Not later than May 03, 2016 23:59 CEST.**
  - Send an e-mail to assignment4@cs.uni-bonn.de.
  - The e-mail subject must be `MoCo-PA Registration`.
  - The e-mail body must be `First Name, Last Name, Matriculation Number; First Name, Last Name, Matriculation Number`
- Submission of solutions:
  - **No later than May 17, 2016 23:59 CEST.**
  - Via e-mail to assignment4@cs.uni-bonn.de
  - The e-mail subject must be `MoCo-PA Solution` followed by your matriculation numbers.
  - The attachment of the e-mail must be a single ZIP file containing all your solutions. The file must be called PA1.zip.
  - After unpacking there have to be three directories *scripts*, *plots* and *doc*. Place all your scripts in the *scripts* directory, PDF files of your plots in the *plots* directory and **one** PDF file with your documentation written out in full (again including all plots you are interpreting!) in the *doc* directory.
- General information about practical exercises:
  - Successful participation in **both** practical exercises is mandatory for the admission to the exam.
  - The practical exercises are to be **solved in groups of two**. In order to discourage abusive copying, all solutions participating in a copy (in part or in whole) will result in a failed exercise.
  - If anything is still unclear, post on the mailing list or ask us.

# Exercise 1: Statistical evaluation of link quality measurements

One of the research fields in our working group are Mobile Ad-Hoc Networks (MANETs) for disaster area scenarios with special focus on routing protocols. The dataset from

> https://net.cs.uni-bonn.de/fileadmin/ag/martini/lehre/16ss/Mobile_Communication/
> AssignSheets/lq.dat.bz2

contains link quality measurements from a static testbed located in a multi-level parking garage. Data Format: *<IP> <Neighbor> <Timestamp> <Link Quality Value>*.

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The *link quality* (LQ), measured at a node A (with IP <IP>) for a connection between the nodes A and B (with IP <Neighbor>), is a real value $LQ \in [0,1]$, giving the packet delivery ratio on the connection $B \to A$ (1 indicating no packet loss).

There is a *link $A \to B$* between two nodes A and B, if B is able to receive packets send by A with a reasonable propability. Especially in wireless scenarios it is up to the application, routing protocol, or whatsoever to define a "reasonable" probability.

A *network topology* is defined as the directed graph G = (V, E), with V the set of nodes and E the set of links between the nodes.

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Analyze the dataset by solving the following tasks:

1. Plot the link quality for each node pair over the time.                                    __/**30**
   - Combine all node pair plots into a single (easy to compare) plot.
   - Add a visualization of the *median, mean*, and *quantils* for each node pair. Give reasons for your quantil choice.

   `Signal Strength`

2. The link quality information can be used to estimate the relative node positions.          __/**15**
   - Give a graph representation of a possible network topology after $\{10, 20, \ldots, 100\}\%$ of the measurement time.
   - Give reasons why the network topology has changed, although, the nodes are static.

3. The link quality values of some node pairs show some abnormalities. Which node pairs show these abnormalities? Give reasons for your choice.                                              __/**10**

4. Some signal propagation models, e.g., the Friis Free Space Path Loss Model, assume a symmetric signal propagation. Perform a correlation analysis of some node pairs. Is this assumption correct?                                                                                     __/**25**

5. Plot the link quality for node pairs 192.168.2.101 - 192.168.2.102, 192.168.2.102 - 192.168.2.108, and 192.168.2.107 - 192.168.2.110 as boxplots. Compare these plots with those from a). Judge the significance of the boxplots in comparision to the plots from a).                         __/**10**

6. Give a link quality histogram for node pair 192.168.2.102 - 192.168.2.108, and 192.168.2.103 - 192.168.2.108. What do you observe?                                                              __/**10**

**Total** ___/**100**

**You need 50 points or more to pass this pracitcal assignment sheet!**

Helpful tools:

- R http://www.r-project.org/

- SPSS http://www-01.ibm.com/software/de/analytics/spss/

- Mathlab http://www.mathworks.de/products/matlab/

- gnuplot http://www.gnuplot.info/

**Good luck and have some fun!**