# Mobile Communication
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## Assignment Sheet #4

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Discussion date: Tuesday June 3rd

Due to some time limitations at the last tutorials (Q&A to the practical assignment sheet, amongst others), exercises 9 and 10 (of sheet #3) will also be discussed in the tutorial on June 3rd.

**Exercise 11:** (Bluetooth ARQ scheme)

In the lecture, you have already seen an example for the ARQ scheme of Bluetooth (section 4.2.3, slide 20). Create a diagram in this manner for the following situation:

A master has two slaves in its piconet. It has data for the first slave that is to be sent in five DM5 packets, and data for the second slave that is to be sent in three DM3 packets. The first slave has data for the master that is to be sent in two DM1 packets, and the second slave has data for the master that is to be sent in five DM1 packets. The master addresses the slaves in a strict round-robin manner, starting with the first slave. Furthermore, transmission failures occur in slots 5, 10, and 21.

**Exercise 12:** (Bluetooth Scatternet formation)

A Bluetooth *scatternet* evolves if a Bluetooth device participates in more than just one piconet at the same time. Thus, this device is able to transfer data from one piconet to the other and might work as a router. Obviously, this device can only be slave in both piconets or master in one and slave in the other. (Why?)

The great benefit of using scatternets is to overcome the restriction of at most 8 devices per piconet by connecting several piconets.

Suppose that a connected scatternet has to be formed out of $n$ Bluetooth devices, which are all in range of each other. The final scatternet has the following properties:

1. A device participating in more than one piconet must be a slave to exactly two masters (a so-called slave/slave bridge).
2. Each master is connected to each other master through exactly one slave/slave bridge.
3. The number of piconets is minimized subject to the previous conditions.

Let $p$ be the number of piconets (i.e. master devices):

a.) What is the maximum number of devices $n$ in a topology with $p = 2$?

b.) Is $p$ bounded? If so, give an upper bound.

c.) Given $p$, derive a formula for the maximum number of devices $n$.

d.) How could your results be used in a scatternet formation mechanism?

**Example Topology**

If the number of devices is $n = 9$, a single piconet is not sufficient since Bluetooth supports only 7 active slaves per piconet. Therefore two piconets are needed ($p = 2$), which have to be connected through a slave/slave bridge:


The remaining 9 – 3 = 6 devices may be distributed evenly between the two piconets: