Universität
Paderborn
Computer networks
group

Winter term 2017/2018

Mobile communications

Homework assignment 9: Cell capacity

Due date: 2017-12-20

Today's only assignment looks at how frequencies can be distributed over cells to combat interference. This was commonly used in GSM, abandonded in UMTS, and is taken up again in LTE, albeit in somewhat modified form. We look at the basic idea of frequency reuse and its impact on capacity in the sense of a simple, GSM-style approach. You might have to google some of the terms used below, but most of it should be fairly straightforward.

1. **Cell capacity**

   Frequency reuse allows a communication system to improve spectral efficiency throughout its deployment area. The repeating regular pattern of frequency reuse among cells is known as cluster. In Figure 1 we represent the deployment of a cellular network composed of hexagonal cells with cluster-size $K = 4$. Numbers in the hexagons indicate the frequency band used in that cell. The system operates with omnidirectional antennas and path-loss coefficient $\gamma = 3.5$.

   (a) Compute the re-use distance D (distance between basestations using the same frequency bands) in relation to cell-radius R.

   (b) Compute the worst-case co-channel interference $\frac{C}{I}$ for cell-edge located mobile stations in *uplink* communication. $\frac{C}{I}$ is the ratio of the received signal power and the sum of the power of the interfering signals. Take into account only the base stations of the first interfering ring.

   In the following assume that the network is sectorized so that each cell is split uniformly into three sectors.

   (a) Compute the cluster size K, the frequency reuse factor F as well as the reuse distance D.

   (b) Compute the co-channel interference for cell-edge located mobile terminals in *downlink* communication. Think which cells you need to include in the interference calculation.

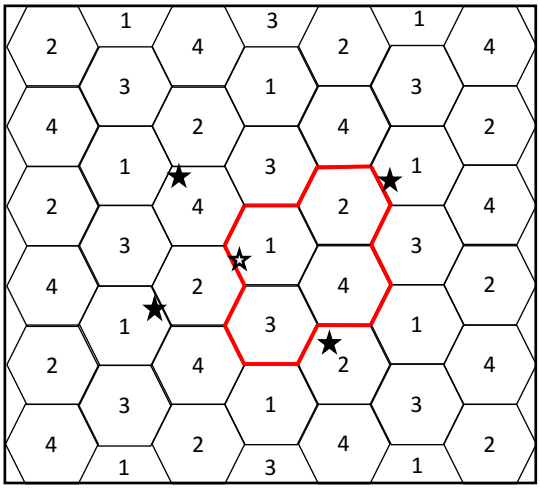

Abbildung 1: Cell layout for a cluster size of 4.

(c) How does user capacity change by means of sectorization?