

Radio Network Planning and Human Exposure to Electromagnetic Fields

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Information is of great value in everyday life. To spread information in a contemporary manner it has to be sent via electromagnetic fields or waves either by wired or by wireless techniques. Concerning the wireless radio techniques information has to be transmitted via air resulting in a human exposure to electromagnetic fields. There are limit values to protect persons from adverse health effects due to electromagnetic fields. For the base station configurations typically used in cellular mobile radio networks the safety distances are just a few meters. Therefore, the exposure is typically not of primary interest in network planning since the resulting power densities are well below the limit values, even in a close distance to the transmitters. In the far field of a source the exposure can be simply measured by the electric field strength or power density.

In this contribution possibilities are analyzed which allow to keep the exposure to electromagnetic fields in mobile radio networks low. In a simplified network configuration the well accepted COST-Hata model is considered to assess the path loss. The effect of changing the cell size on the power densities caused by the base stations is evaluated. As in practice, the antenna height and downtilt of the considered sector antennas are assumed to be dependent on the cell size. It is shown that increasing the base station density will not generally raise the exposure but can rather help to lower it significantly. Thus, there is no need to limit the number of base stations. Transmit power control at the base station might help to reduce the interference. However, the emerging power density is hardly affected by allowing a power reduction at the base station for individual links. In contrast to this, it is demonstrated that transmit power control at the mobile station is a helpful means to lower the exposure efficiently. A small number of users per base station, small cell sizes, and a large power control range at the mobile station are very promising ways to achieve a low exposure.

The main focus is on GSM systems. Similarities and differences to UMTS and broadcast systems are also highlighted. Part of the work presented is funded by the German government in the project *miniWattII*.