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TKN Telecommunication Networks Group

Head of Group
Prof. Adam Wolisz

Faculty of EE and CS

bmb+f Vorhaben *miniWatt*

The miniWatt Project

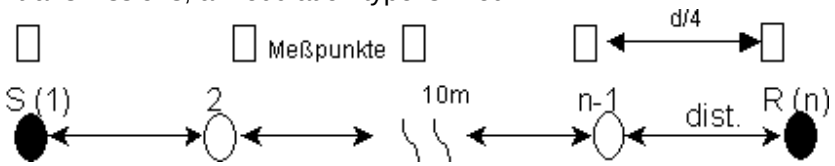
Introduction

The Miniwatt project is a joint effort of several German universities and companies, funded by the German government. Its goal is to investigate and develop mechanisms to reduce the electro-magnetic exposure that is caused by wireless mobile communication. The activities at the TKN TUB group are focused on exploiting (ad hoc) multi-hop communication principles to reduce transmission power as a means to reduce electro-magnetic exposure immitted power and / or energy. The constraint is that multi-hop communication should not reduce the end-to-end capacity of a network.

Scenario

The communication system

More specifically, we investigate an idealized ad hoc network: A sender and a receiver are d meters, and a variable number of relay nodes is equidistantly placed between them. Using an IEEE 802.11 simulation model, the sender transmits a fixed amount of data to the receiver, using all available relay nodes. For all transmissions, a modulation type is fixed.



The transmission power between any two nodes is set such that (for the given modulation) the *idealized* packet error rate over the entire relay transmission does not exceed a given target error rate - if all the transmissions were to take place independently.

In fact, as transmissions can overlap, the *actual* packet error rate is computed based on instantaneous signal-to-noise values, which are mapped to bit error rates for each individual bit (taking into account the chosen modulation), and then summarized into a decision whether a packet is corrupted (if even a single bit is corrupted).

Measuring immitted power

As the project deals with the electromagnetic radiation that is received by humans, the actual emitted power values are not relevant. Instead, we placed five "measurement points" in parallel to the linear arrangement of stations. At each of these measurement points, we computed the power and energy that is received at each of them over time.

Main results

Main results are:

- In principle, a lot can be gained:
  - Emitted power reduced considerably
  - Average imitted power, total imitted energy and immited energy at the peak power level is reduced
  - However: Throughput consierdably lower and peak power values can increase slightly
- Maintaining throughput by gearing up the modulations used between two neighboring

terminals: Still a gain compared to direct communication, but not by several orders of magnitude

Consequences

These results indicate the following consequences:

- The main problem is that no reasonable pipeline effect established itself
- A more centrally oriented access control for an 802.11 multi-hop scheme might be beneficial in such scenarios
- Directed antennas should mitigate some of the problems
- Clear Channel Assessment (decision of sending a packet) should not be based on the received RF power threshold. Instead, the SINR of neighbor nodes should be taken into account to make a decision about transmission and the necessary RF power level.

An extensive discussion of results and conclusions will be presented in a future paper.

Contacts

If you are interested in more information, please contact one of the following persons:

- Jean-Pierre Ebert
- Holger Karl

- B. Matzen, J.-P. Ebert, and H. Karl, "Electromagnetic immission reduction for radio communication networks by using a multi-hop ad hoc approach", Technical Report TKN-03-004, Telecommunication Networks Group, Technische Universität Berlin, February 2003. (PostScript) (PDF)