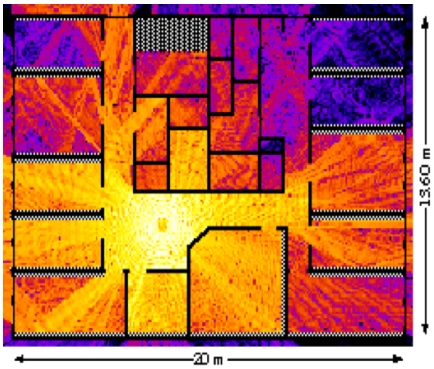
Master's Thesis

Provisioning radio fallback for directional wireless channels



Wireless technologies have traditionally been challenged to provide sufficient data rates. This has been true in both consumer-oriented systems (e.g., mobile cellular systems like 3G or LTE) as well as industrial-oriented systems (e.g., industrial radio systems, systems for wireless factory floor automation). Currently, a promising approach to overcome this shortage is to make use of novel frequency bands, e.g., 28 GHz or 60 GHz (so-called millimetre wave or mmWave systems) or to use infrared or visible light for communication (VLC). While these frequency bands provide ample bandwidth, allowing to realise high data rates, they come with a significant downside: The propagation of the electromagnetic wave becomes *quasi-optical*, meaning that line-of-sight between sender and receiver is effectively required. Combined with a relatively narrow beam, even small rotations of a device can lead to dramatic changes in transmission quality, abruptly disrupting a link that was transmitting at gigabit/s just a few milliseconds earlier. Moreover, sharing such links between multiple devices (e.g., an access point serving two user devices) incurs higher overhead than in non-directional technologies (beam tracking overhead).

For such situations, conventional error control techniques (like forward error correction or automatic repeats) are no longer suitable or would incur unacceptable delays. We hence need to look for other fault-tolerance approaches. Specifically, in this thesis, we are interested to understand how a directional wireless system like mmWave or VLC can be accompanied by a conventional radio system to act as a fallback system.

This thesis is part of cooperation activities with the Computer Networking (Prof. Karl) and Control Theory (Prof. Quevedo) groups.

Goals of the thesis

The goal of this thesis is to specify the requirements for a radio fallback system, design an overall system approach spanning across directional and non-directional links, and provide some first insights into quantitative tradeoffs. achieved can be agreed upon at the start of the thesis. Possible milestones are as follows:

- Identify literature on fault-tolerance mechanisms for directional wireless channels;
- Define a number of models and provide plausible example values;
- Describe the resulting scheduling problem;
- Develop a solution for the scheduling problem. Possible approaches are to come up with a suitable optimisation problem or find a plausible heuristic;
- Evaluate the proposed scheduling algorithm; show advantages and disadvantages compared to non-fault-tolerant versions. Evaluation can be done using different methods, e.g., simulation or analysis.

Keywords

Wireless networking, scheduling and resource allocation

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