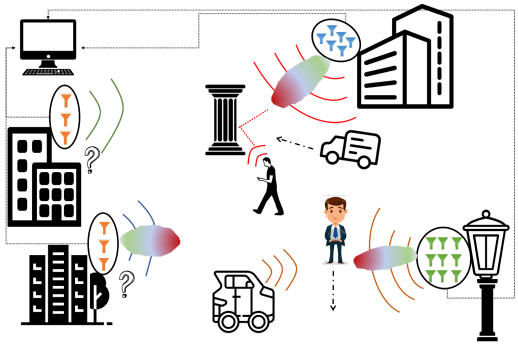
Title: **Smart Blockage Adaptation of Distributed mmWave Base Stations for post-5G/6G Communications & Sensing**

Project description:

As 5G equipment is under standardisation and deployment today, research is growing to post 5G/6G technologies where frequencies above 39 GHz (mmWave band) are operated for multiple-input-multiple-output (MIMO) systems deployed as nano-cells due to rapid decay of power.

Such base stations steer "pencil"-like narrow radio beam to desired direction of target user. However, the beam is easily blocked by moving objects, e.g., human, vehicles, which may cause deep fading influencing link quality and thus re-steering of beam from base station is needed.



This project studies the dynamics of blockage (human/vehicle in mobility), the influences of blockage to radio communication links, and the decision-making strategy.

Keywords: **post-5G/6G, mmWave distributed MIMO, blockage, deep fading, adaptation, real-time, off-line**

Availability: **several master students; this project is monitored in a multidisciplinary manner by 3 supervisions from EE, CS, and M.**

Topics:

1. **Applied Mathematics:**
   Robust optimization for smart deployment of base stations subject to coverage and link quality requirements.

   Prerequisites:
   Optimization Modeling course (mixed-integer programming, Benders' decomposition, cutting planes), Python or C/C++. Motivation for interdisciplinary collaboration and learning about the radio systems foundations (Electrical Engineering) of this project.

2. **Electrical Engineering:**
   Interaction mechanism between mmWave radio and (humans+)vehicles & feasibility study on sensing based on radio signals

   Prerequisites:
   * Familiar with and interested in fields & waves, electromagnetic waves theory, antennas, signal processing

   * Hands-on coding and measurement skills

   * Motivated for interdisciplinary collaboration

3. **Computer Science:**
   Models and model-based algorithms for real-time decision-making – for choice of base station and beam path to user – subject to the inherent uncertainty (i.e. random effects), and optimising for energy efficiency.

   Prerequisites:
   Experience with model-based analysis methods – based on simulation or model checking – as taught in the Quantitative Evaluation of Embedded Systems, System Validation, Performance Evaluation, or Modeling and Analysis of Concurrent Systems courses. Motivation for interdisciplinary collaboration and learning about the radio systems foundations (Electrical Engineering) of this project.

We will start with simple models/assumptions and simulations.

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We look forward to your contact!