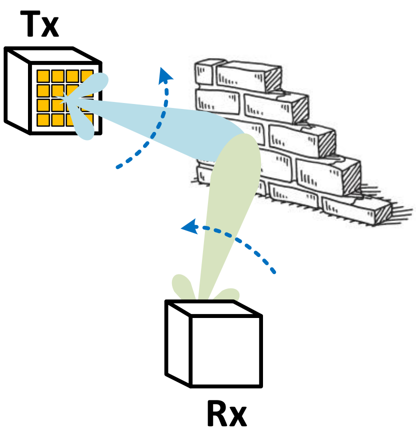
Device localization with 5G 28 GHz mm-wave beamsteering arrays

Motivation

The 5G standard dedicated several gigahertz of bandwidth around 28 GHz for high-rate, low-range communications. To overcome the large path loss at millimeter-wave frequencies, large antenna arrays are required. We developed a pair of 28 GHz software-defined radios (SDRs), using conventional SDRs for generating the baseband signals, and a 16-antenna array for beamsteering. With our setup, signals with bandwidths up to 100 MHz can be generated, and the transmitter and receiver beams can be steered in azimuthal and elevation space through a digital control link.
Since the transceiver's beams are quite narrow, it is possible to identify the angle-of-arrival and angle-of-departure of the signal, which eventually allows to locate the transmitter node. High-accuracy localization of transmitters in 28 GHz is one of the many benefits of 28 GHz communications in 5G.



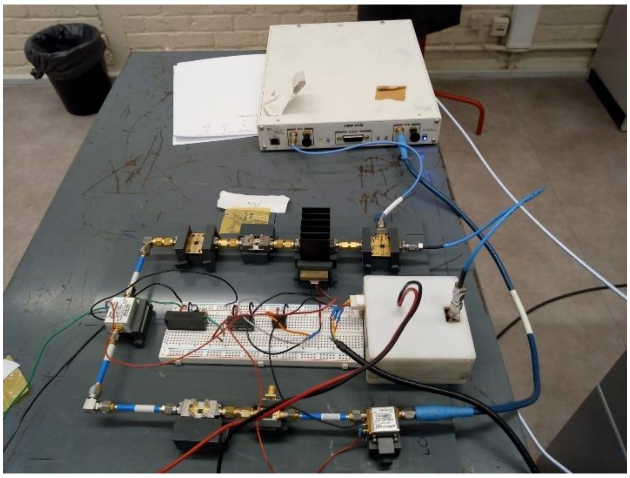


Figure: Concept of beam scanning at 28 GHz and picture of our 28 GHz SDR

Objective
This Master's thesis will investigate the localization of a 28 GHz Tx in a beamsteering 28 GHz system. The main problem is that the process of changing the beam's direction is not instantaneous, but rather takes between 1 and 10 milliseconds. Performing a full scan of all Tx and Rx directions is not a feasible option in practice. Therefore, different localization and tracking algorithms should be investigated (based on Kalman filters or particle filters) to allow for real-time tracking of moving transmitters. The algorithm could use only the array at the Rx side, or both Tx and Rx arrays. The proposed algorithms will be implemented and evaluated experimentally using the 28 GHz testbed, and the localization accuracy will be investigated.

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