# Popular Science Summary

The upcoming 5G-New Radio (NR) Standard will enable cellular communication in the 5G mmWave frequency bands, 24-100GHz. These frequency bands will open for large system bandwidth and tremendously high data rates enabling lots of new use cases, such as smart cities, connected cars, medical applications and much more! Given this cutting-edge technology, exciting challenges arise for today's RF designers that require state-of-the-art solutions.

High isotropic path loss between radio transmitters and radio receivers makes it necessary to rely on antenna arrays with many antenna elements. mMIMO stands for massive Multiple-Input-Multiple-Output. This means using multiple antennas on the same frequency band, with massive indicating a high number of such antennas. Making these antennas directional through mMIMO, the 'beamforming' principle is used to focus the transmission on the direction of the receiving party, may overcome the issues with isotropic path loss.

Traditionally, 5G mmWave has been used more for short-range communication due to its inherent characteristics and propagation loss, but in combination with mMIMO and beamforming it will take the next generations of cellular communication to new levels. Small antennas needed for 5G mmWave open possibilities to integrate the RFIC, front end radio modules, filters, and antenna element in a single RF chip. This fact, in combination with 5G-NR is standardized for communication also over 5G mmWave radio frequencies which enables mmWave communication in smartphone and IoT devices, will drastically change the way beamforming will be implemented in mobile devices in the future.

In our Master Thesis, we propose a dual band single polarized patch antenna design for the 5G mmWave frequencies and obtain gain and radiation patterns for the required frequencies at 28GHz and 39GHz that are further simulated in a MATLAB link level simulator to analyze the performance of 5G mmWave handheld devices in a non-stationary radio environment to obtain an omnidirectional coverage in desired directions.