Antenna Performance Evaluations in 8×8 MIMO Access Points

Mehrbod Mohajer*, Adil Hussain, Eyal Hochdorf, Andy Friefeld, Steve Beaudin
Qualcomm Inc., San Jose, CA, USA

The latest version of WiFi, 11ax, recommends the option of 8 antennas for MIMO communication systems. 8×8 Access Points (APs) not only enhance data rates for SU-MIMO, but also enable MU-MIMO feature to support more clients. Although a greater number of antennas seems compelling to improve the wireless communication performance, the antenna accommodation is very challenging when it comes to APs with small form factors. Antenna characteristics such as antenna positions, orientations, polarizations, and radiation patterns play a key role to provide eight spatially distinct streams for MIMO communications. Hence, it is crucial to design and analyze MIMO antennas for the optimal wireless communication performance in the given AP platform.

Qualcomm Inc. is one of the pioneers in offering 8×8 / 8 spatial stream MIMO WiFi solutions to the market. Although extensive Over-The-Air (OTA) measurements can be performed, it can be very time-consuming, costly, and tedious to find optimal antenna parameters. Thus, a powerful tool has been developed to simulate OTA performance measurements and optimize MIMO antennas in a systematic way as follows:

1- A MATLAB code has been written to simulate the physical channel model in the given OTA environment with two turn tables for 360-degree measurement system.
2- The simulated and measured field radiation patterns of MIMO antennas can be imported into the MATLAB code. The antenna orientations and positions can be arbitrarily adjusted as optimization variants.
3- Considering the field radiation patterns, polarizations, antenna positions as well as parameters specific to each transmit and receive chain, the channel transfer matrix between Tx and Rx is calculated for each antenna realization.
4- Calculated channel transfer matrix is linked to SystemVue simulation setup where the packet error rate (PER) waterfall curves are simulated for various Modulation Coding Schemes (MCS) and Number of Spatial Streams (NSS) in an 8×8 11ax communication system. According to IEEE standard, minimum of 10% PER will determine the sensitivity of WiFi receiver for each MCS and NSS.
5- For each physical channel realization (antenna parameters and turn table orientation), the highest MCS and NSS is determined to find maximum possible throughput.
6- Calculating the min, average, and max throughput for 360-degree horizontal angles and for various antenna parameters, the optimum antenna configuration can be achieved.

Certain antenna configurations are analyzed through the proposed approach, and the results are compared to OTA measurement data to investigate how accurate the developed tool predicts 8×8 11ax system performance. Additionally, various antenna configurations and parameters are investigated to propose a guideline for the antenna design in 8×8 MIMO system with limited AP size.