Measurements and De-embedding Techniques for 5G Millimeter-wave Arrays

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The millimeter wave (mm-wave) spectrum is a key area of research for high data rate wireless communication. Recently, the Federal Communication Commission (FCC) opened 11 GHz of bandwidth already between 28 and 71 GHz for 5G communication. However, measurement and accurate characterization of antennas and systems at these frequencies remains a key challenge.

Direct measurement of a mm-wave antenna at 60 GHz is a challenge. A key issue is the small antenna size, and direct contact to the feed port introduces perturbations that can fully distort results. Currently used probe structures are often quite large compared to the antenna-under-test (AUT), impeding gain and scanning pattern measurements. Given the stated measurement challenges, a test structure will be presented surrounding the AUT. A conventional de-embedding technique will then be used to extract the impedance and antenna S-parameter data points to be used for extracting Γ_A, the AUT reflection co-efficient. Specifically, Γ_A will be computed from

$$\Gamma_A = \frac{\Gamma_M - b}{-c\Gamma_M + a} \tag{1}$$

The variables *a, b* and *c* can be solved using the open, short, and load models, and Γ_M is the reflection coefficient in presence of all the structure components.

Pattern measurements present additional challenges. Even minor perturbations in the array can cause phase anomalies during the measurement. Therefore, we will present an error-correcting post-processing technique that will account for minor offsets in the measured array on the rotating platform. To obtain the entire array pattern, we will employ unit excitation active element pattern (UEAEP) technique.

All aforementioned measurement techniques: 1) mm-wave AUT de-embedding, 2) gain measurement post-processing, and 3) UEAEP will be analyzed and conducted for a 60 GHz array. At the conference, measurement and de-embedding results will be discussed and presented.