Antenna MIMO and Co-existence Characterization for Next Generation Smart Phones

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With the growing demand for higher channel capacity and reliability in smart phones, antenna system design has become more sophisticated due to the use of MIMO radio solutions to achieve the required performance. These MIMO solutions drive the need for multiple same system antennas for each communication standard. When confronted by the physical constraint of the industrial design, these multiple antenna solutions result in antennas for each standard being in close proximity to each other, and hence present a multi-faceted antenna system design challenge.

Since the MIMO system relies upon de-correlated channel characteristics to achieve its maximum performance capability, large intra-system antenna spacing ($>\lambda/2$) is highly desirable but seldom available especially in the lower frequency cellular bands (700 MHz to 960 MHz). As a result, other antenna design methods (e.g. polarization and pattern diversity) have been developed to enhance the de-correlation between closely spaced low frequency elements within a small platform at the expense of bandwidth and radiation efficiency. In addition, with multiple MIMO enabled communication systems being implemented within a small platform (e.g. LTE and WLAN), the interference between systems, due to over the air coupling between the multiple antennas, needs to be addressed as a platform system design issue. As a result, individual antenna characterization and two-port insertion loss measurement can no longer provide an accurate prediction of radio system performance. In addition, MIMO and co-existence characterization are required to measure the overall antenna system. At the same time, the individual antenna measurement can still be used as a tool to provide insightful information of the system.

This presentation focuses on the two most common antenna systems on a smart phone – cellular LTE MIMO module and WLAN 2G and 5G MIMO module - and studies the impact of MIMO performance and inter-system co-existence on the overall system performance from the pragmatic perspective. As cellular and WLAN antennas are closely integrated on the handsets, their performance increasingly depends on the individual antenna, their correlations and their cross-coupling. More antennas do not always lead to a more robust system. This study also defines and clarifies the MIMO testing method using a state-of-the-art MIMO spatial channel enabled chamber, as at this time there is no standardization available in this area. A positive correlation of antenna coupling and system throughput will be demonstrated and discussed as well. A comparative study will be given to illustrate the design tradeoff in MIMO antenna systems.