Low Cost Millimeter Wave Antenna for 5G Base Station

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In 5G network, millimeter-wave (mm-wave) communication has been treated as a key solution of current issues including limited bandwidth and restricted channel capacity. To apply mm-wave communication in 5G network, the major change in antenna design from conventional way should be considered. One of the significant change for mm-wave is an antenna-in-package (AIP) which antennas are integrated with radio frequency (RF), intermediate frequency (IF), and local oscillator frequency (LO) lines in a multilayer circuit board. The AIP results in increasing complexity of fabrication with high manufacturing cost. In addition, radiation efficiency decreases when entire antenna structure is set in dielectric material.

In this paper, a practical and low cost antenna design and its antenna performance including enhanced radiation efficiency are presented. First of all, the presented antenna has air cavity double stacked patch structure and locates on top side of the multilayer circuit board. The proposed structure is implemented using flexible printed circuit board (FPCBs) and stainless steel (SUS) supporter. All feed lines, also known as RF lines, IF lines, and LO lines are built in the circuit board and there is an additional small high-end circuit board that links between RFIC and the multilayer circuit board.

Each antenna element including the feeding line has more than 3 GHz 10dB return loss bandwidth in measurement. When the 64 antennas are arrayed with half lambda spacing, the measured gain at 39 GHz is higher than 23 dBi. Phase of input signals to the 64 chain arrayed antenna are modified to tilt radiation direction for measurement of beam scan range. To evaluate set-level EIRP and beam steering, performance of the antenna equipped with a commercial base station unit is measured. The presented antenna is recently applied in a commercial base station for 5G network. This work shows the latest trend taking into account not only major consideration of designing mm-wave antenna for 5G network but also manufacturing cost. By applying the presented antenna design, the dramatic cost reduction of PCB manufacturing is achieved without performance reduction. The antenna structure will be used on every mm-wave product and be able to help communication companies set 5G network earlier with economical budget.

More detailed analysis and application to other 5G products portfolio will be presented in the conference.