60GHz Massive Planar Lens Antenna

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Massive scale antennas are inevitable when wireless communication system is required to increase system gain as cost-effectively as possible. For example, an increase in the performance of power amplifiers comes at the expense of high cost and heat issues. Definitely, a reliable choice is to increase antenna gain leading to massive antenna configuration. A typical way to increase antenna gain is to increase the number of antenna elements. It goes without saying that this is an excellent choice at low frequencies such as several gigahertzes. However, this approach is confronted by a fundamental limit when the operation frequency goes up to millimeter-wave frequencies such as 60GHz. From a certain point the feed loss goes over the gain coming from the increase in the number of antenna elements leading to saturation in passive gain. This limit in increasing antenna aperture size can be overcome by employing a large-aperture lens structure interacting with the propagating electromagnetic waves instead of interacting with complicated feed structure suffering from substrate losses. In this massive lens antenna system planar lens technology that can be fabricated by commercially available PCB fabrication process is a promising candidate to substitute the conventional curved dielectric lens suffering from bulky size and high cost.

This paper presents a 60GHz massive planar lens antenna consisting of a large-aperture lens with the dimension of 60λ X 60λ and feed array. Planar lens technology enabling high gain enhancement factor over 20dB and ultra-thin configuration is presented. First, overall performance of the proposed antenna is discussed based on full-wave simulation results and its practical usage is presented from the aspects of fabrication and system features. Finally, it is shown that measurement results validate the simulated performance and features of the proposed antenna.