Lithographically-fabricated Ultrawideband Phased-Arrays for Agile mmW Connectivity

Seckin Sahin, Nima Ghalichechian, Niru K. Nahar and Kubilay Sertel
ElectroScience Laboratory, The Ohio State University
1330 Kinnear Rd, Columbus, OH, USA

Unused millimeter-wave (mmW) bands must be harnessed to sustain the explosive growth in wireless connectivity. By 2020, more than 50 billion wireless devices are projected to be connected (Rangan, et. al., IEEE Proc., vol. 102, no. 3, pp. 366-385, March 2014). In order to sustain the quality of service (QoS) for each device connected to this Internet of Things (IoT), new signaling, transceiver and antenna technologies are being developed.

Although more traditional methods to improve QoS have been available (such as more efficient coding schemes, multiple-input-multiple-output links, micro-, femto- and pico-cells, etc.), much wider bandwidths available in the mmW bands offer unique advantages as well as associated challenges. For example, thanks to the much smaller wavelengths, antennas can be directly integrated with transceiver electronics, leading to substantial cost savings. However, such antennas are known to exhibit strong coupling into the substrate and thus suffer from low radiation efficiencies, where <10% overall efficiency is considered acceptable for a typical on-chip antenna. In addition, atmospheric absorption in the mmW band requires high-gain antennas to compensate for the path losses. As such, frequency- and beam-agile phased arrays are needed to adapt to the dynamics of typical mobile channels. Also, as noted above, cost-effective fabrication methods for such arrays must be readily available.

In this work, we develop an ultrawideband (20-90GHz), on-chip phased array that can be lithographically fabricated directly onto the CMOS transceiver substrate. The design is based on the current sheet array concept by late Prof. Munk of the Ohio State University. We are currently developing the lithographic fabrication steps to realize a 3x3 phased array prototype. We will present the design details and discuss our progress on the fabrication.