Experimental Characterization of the Propagation on the Human Torso at W Band

A. Brizzi*(1), A. Pellegrini(1), Y. Hao(1)
(1) Queen Mary, University of London, UK

Interest in the use of millimeter wave frequencies for body-centric applications has been recently growing, also thanks to the advances in the realization of compact devices working at V and W bands. In addition, many potential benefits are connected to the presence of unlicensed portions of the spectrum around 60 GHz and 94 GHz, and the possibility of reaching data rates in the order of Gb/s (J. Wells, IEEE Microw. Mag., 3, 104-112, 2009).

However, the use of millimeter waves for body-centric applications poses remarkable challenges, mainly relevant to the electrical dimensions of the human body and the dielectric properties of its constituent tissues. Moreover, the presence of clothing cannot be neglected, since their thickness is now comparable with the wavelength. Initial analyses of on-body propagation have already been carried out at 60 GHz and, in a more limited way, at 94 GHz highlighting the differences with the lower ISM and UWB frequencies. Nevertheless, further investigations are necessary in order to achieve a satisfactory characterization of the body-centric propagation channel at millimeter wave frequencies.

To this aim, an experimental investigation of the path loss over the trunk of a human male together with a path loss model useful for link budget evaluation will be presented was carried out. The analysis has been performed at 94 GHz: a transmitter was placed on the left side of the waist of a human subject (representing a device attached to the belt), and the received signal was sampled over a grid of 143 points with a spacing of 3 cm. The minimum distance between transmitter and receiver was 10 cm, and the grid had dimensions 30 × 36 cm, thus covering the chest and the upper part of the abdomen. Different garments were considered, and the data from each set of measurements were analyzed in terms of path loss exponent and shadowing factor (T. S. Rappaport, Wireless Communications, Prentice-Hall, 102-106, 2001). This allowed to obtain path loss models useful for link budget and channel capacity evaluation. The measurement results and modeled parameters will be shown during the presentation, also highlighting how the different clothes worn by the subject affect the propagation over the torso.