Effects of Base Station Antenna Types and Locations on Indoor Channel Characteristics

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The purpose of this study is to characterize the arrangement of base station antennas in indoor environments. The specification that we investigate is the fifth generation (5G) mobile communications, and the frequency bands are selected as millimeter wave. In this scenario, the conventional type of antennas for indoor base stations is array antennas. These antennas are designed to have the feature of beam steering or switching; however, we aim at providing a detailed comparison on the effect of antenna types. We analyze the indoor channel characteristics by using an antenna consisting of multiport sub-arrays, which have fixed beam properties and achieve high gain and broad angular coverage simultaneously. By placing a receiving antenna located all over a room one-at-a-time, the resultant cumulative distribution function (CDF) of received power between each type of antennas is analyzed, and so do the channel attenuation statistics. These data are evaluated via ray tracing simulation and wideband measurement. By such, the optimum type of base station antennas can be determined.

On the other hand, this study clarifies the effect of the location of a base station antenna. The effect of two indoor locations, including the side and the center of a room, is investigated. When the base station antenna is put on the side wall, the antenna consists of linear sub-arrays, and their patterns are steered to different directions. Outputs from each port are then maximally-ratio-combined. As the antenna is located at the center of the room, the four sub-arrays are directed to distinct right angles. The CDF of received power and the channel attenuation statistics are again evaluated as the performance indices, and the influence of base station locations is thus determined. It is hoped that this work provide guidelines for millimeter-wave indoor base station design.