Evaluation of transmission quality of indoor users using low site base station with vertical multi-beams

Tsutomu Mitsui[(1)], Kentaro Nishimori[(1)], and Takefumi Hiraguri[(2)]
(1) Niigata University, Niigata, Japan
(2) Nippon Institute of Technology, Saitama, Japan

Active array antenna system (AAS) is being developed for the next generation base station. The AAS has the function of forming a plurality of beams from one base station and controlling the beam shape and beam direction in addition to the function of constructing a plurality of sectors in the vertical plane.

Generally speaking, a vertical pattern control has been widely used for the interference reduction among adjacent cells. Recently, multiple input multiple output (MIMO) using the vertical pattern control and dual polarizations was proposed, in order to discriminate the near and far located users for the base station when considering micro cell scenario. In addition, instead of the conventional three sector using the horizontal patterns, a configuration with two sectors, where two vertical patterns with the difference directions for near and far located users, was proposed: this is called *ring-omni cell*. However, in the previous studies, the outdoor scenario is basically focused, because the base station is generally located at the top of building to obtain the wide service area for a given frequency and beam patterns at the base station.

In this paper, we propose an application to small cells considering from outdoor to indoor environment by the AAS using the multi-beams in the vertical plane. For small cells which are assumed in 5-th mobile communication system, it is necessary to secure the transmission quality of a wide range of indoor users from a low located base station. In this paper, a method to improve the system capacity by vertical multi-beams is proposed.

In the evaluation, a practical propagation path loss model, which is cited as 3GPP model, is used. In the practical condition, when considering indoor environment with 8^{th} floor, the base station is located at 4^{th} floor. The performance of the vertical multi-beam configuration assuming small cell base stations is evaluated, when the number of arrays is changed. It is clarified that the vertical plane array of 12 elements is optimal at the array element interval of 0.6 wavelength constituting the beam number of seven from a point of view on the beam width and the interference reduction among adjacent beams.