

## Mean Effective Gain of Mobile Antennas in Line-of-Sight Street Microcells With Low Base Station Antennas

Atsuya Ando, Tokio Taga, Akira Kondo, Kenichi Kagoshima, and Shuji Kubota

A method for evaluating the mean effective gain (MEG) of mobile antennas in line-of-sight (LOS) street microcells with low base station antennas is investigated. The received power patterns of incident radio waves along typical streets measured in actual street microcells in urban areas of Tokyo are presented to clarify the proper distribution model for the incident radio waves. A two-dimensional statistical distribution model is proposed based on the measured received power patterns for the incident radio waves that follow a Gaussian distribution in the azimuth angle, but are concentrated in the horizontal plane in the elevation angle. The two-dimensional theoretical expression of the MEG that consists of the incident distribution model function and the radiation patterns in the horizontal plane of the mobile antennas is derived to evaluate easily the MEG. We show that the MEG values in street microcells are not defined as only one value and form the MEG pattern because the MEG values are changed by the relative direction of the radio waves arriving at the mobile station antennas. The measured and calculated MEG values (MEG patterns) of the whip antennas used in the experiments are in good agreement. The average error between the measured and calculated MEG values is within approximately 4.5 dB at maximum. The results show that the MEG degradation of the mobile station antennas due to the effect of the human body is probably evaluated by the proposed distribution model. The proposed statistical distribution model is valid and effective in both estimating the MEG values of mobile antennas and designing the LOS street microcell systems with low base station antennas.

*Index Terms* Line-of-sight (LOS) street microcells, low base station antennas, mean effective gain (MEG), mobile antennas, statistical distribution model of incoming radio waves.