Channel Modeling of a Partially Open Drain at 2.4 GHz

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As wireless communication becomes more ubiquitous, there is a steadfast growing need to accumulate the propagation knowledge in small radio cells because they can increase the capacity of radio networks and overcome radio spectrum crowding. For these small radio cells that are intended to cover mainly indoor or very small outdoor areas their base station antennas are usually mounted inside a building or below rooftop level in an outdoor environment. In such scenarios when the lower base-station antennas are used, various objects that exist in that particular environment may affect radio propagation significantly so their effects should be studied.

In this work, the focus is placed on a partially open drain, whose presence is a common sight in many Asian cities. Particularly, this research attempts to investigate the propagation characteristics of a radio signal inside a partially open drain at 2.4 GHz, using ray tracing of image method approach. The numerical result obtained from ray tracing simulation is then compared to a previously published measured result (S. Y. Lim and C. C. Pu, IEEE APS Magazine, 54, 3, 148-156, June 2012).

For the partially open drain environment, its propagation characteristics resemble to a certain degree that of the tunnel environment. Specifically, both the tunnel and the partially open drain environments constitute confined spaces with several surrounding reflecting walls, except for the partially open drain, there is one less reflecting wall on the top. Yet these two environments are different in nature since the former has been well perceived as a waveguide structure while the latter is more of a leaky waveguide structure.

In this paper, the fundamental propagation mechanisms such as the direct ray, multiple reflections from the drain walls, and ground reflection from the partially open drain floor are scrutinized. Detailed knowledge of the partially open drain's parameters such as the dimensions, shape, materials electromagnetic properties, surface roughness, water content and the position placement of the transmitting (Tx) and receiving (Rx) antennas will be presented at the meeting.

The comparison of the simulation results obtained from this study to the measured results provides useful information for designing wireless communication systems in environments where such structures exist.