Propagation Modelling in the Presence of Electrically-Large Inhomogeneous Lossy Dielectric Structures

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Indoor wireless communication systems, in particular those conforming to the IEEE 802.11x standards, are proving to be enormously popular. As these standards specify only a limited number of channels, careful planning is required prior to system deployment if unacceptable levels of cochannel interference are to be avoided. Excessive interference can detrimentally affect both quality and capacity, and accordingly strategies which can reliably minimise interference are needed. The nature of the propagation process is clearly crucial in determining both coverage and interference, and so techniques which can reliably characterise propagation are required. The indoor environment presents many challenges in this regard — a range of materials, inhomogeneous structures and variations in construction methods — can all influence propagation to varying degrees. A notable example of this is steel-reinforced concrete, which is common in multifloor buildings and is well known to have a significant effect on the propagating fields. Some work has already been directed at characterising the infinite 2D steel-reinforced concrete wall (R. Paknys, IEEE Trans., AP-51, 2852–2861, 2003) and the finite dielectric wall corner (M. J. Neve, *et. al.*, USNC/URSI Nat. Rad. Sci. Mtg., 2005). Research is now well advanced at extending this work to consider more representative structures (as encountered in real buildings) with the intention of extracting a mechanistic characterisation of the propagation for use in system planning. In this regard, the presentation will focus on two areas namely (a) the use of the FDTD to model propagation across a building floor; and (b) the development of a technique for approximating the location of poles for a lossy dielectric slab.

The FDTD has been shown to be effective in the characterisation of propagation around and through a dielectric wall corner. This work has now been extended to consider an entire building floor, a salient feature of which is a large steel-reinforced concrete services core. This geometry has been extensively measured, and 'traditional' characterisation methods involving ray-tracing have been shown to be ineffective. For this reason a full-wave approach is required, and given the electrically-large nature of the problem a 2D FDTD algorithm has been implemented. Results show that transmission *through* the concrete core is the dominant propagation mechanism, which is a significant result for system planners.

A recently published technique for approximating the location of surface and leaky wave poles for a lossy dielectric slab will also be presented (M. J. Neve and R. Paknys, IEEE Trans., AP-54, 115–120, 2006). The problem is reduced to the simultaneous solution of two transcendental equations for each of the PMC and PEC cases which is shown to yield a simple approximate solution for both surface and leaky wave poles. These estimates can be subsequently refined using numerical optimisation. Several examples of the application of this technique will be presented.