

INDOOR CHANNEL MODELING AT 60 GHz FOR WIRELESS LAN APPLICATIONS

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Abstract - This paper reports narrowband and wideband results derived by propagation modeling at 60 GHz for indoor WLAN applications. A multi-ray model is proposed and verified through a simulation process. The propagation in the site-specific environment can be described using 4-5 rays without reducing the accuracy of the results. RMS delay spread varies with distance from 0.57 ns up to 2.32 ns. Coherence bandwidth for 0.9 correlation was found 65 MHz, 116 MHz and 87 MHz for isotropic, omni-omni and horn-horn antenna configurations respectively.

Keywords - wireless LAN, wideband channel, delay spread.

I. INTRODUCTION

Multimedia and computer communications are playing a major role in today's society, creating new challenges for the development of telecommunications systems. The pressure for wireless systems to cope with increasing data rates is enormous and Wireless Broadband Systems (WBSs), which are systems with rates greater than 2 Mbps, are emerging rapidly [1]. We can mention enough system cases that may modify the WBSs' perspectives, but two main approaches have come to light. The Wireless Local Area Networks (WLANs), which are focused on computer communications and Mobile Broadband Systems (MBSs) [2] focusing on cellular systems providing full mobility to B-ISDN users.

For the development of the mentioned broadband systems, wide frequency segments have been allocated in the millimeter region of the spectrum and especially around 60 GHz. In millimeter wave frequencies, the propagation modeling, apart from the known empirical models, can be realized based on geometrical optics using ray-tracing theory. In the 60 GHz region the diffraction phenomenon can be neglected, and the sum of the direct ray and the reflected rays is enough to describe the behavior of the propagation channel with great accuracy [1,3]. The modeling in extremely high frequencies poses the problem of the accurate description of the propagation scenarios at the wavelength scale (5 mm at 60 GHz). Hence the main target is to describe the main obstructions and the surfaces that affect the signal propagation. The description is not only in terms of the geometric characteristics of the propagation environment but also in terms of the surface electromagnetic parameters (relative dielectric constant,

losses etc) in order to extract the surface reflection coefficients.

In this paper we present a multi-ray model in order to describe the signal propagation at 60 GHz in an indoor environment. The model's validity is verified through a simulation process from the narrowband and wideband point of view of the channel respectively. The propagation mechanisms are explained analytically whereas channel parameters such as RMS delay spread and coherence bandwidth are calculated.

This paper is organized as follows. Section II deals with the propagation modeling describing analytically the geometry of the environment under consideration, the proposed multi-ray model and the simulation procedure. In Section III, LoS propagation results are presented from the narrowband point of view, explaining the mechanisms and the behavior of the signal propagation. Section IV, deals with results from the wideband point of view in order to evaluate the wideband channel parameters. Finally, Section V is devoted to discussion and conclusions derived by the entire simulation procedure.

II. PROPAGATION MODELING

A. Description of the Environment Geometry

The simulation environment is a long corridor with dimensions $44 \times 2.20 \times 2.75 \text{ m}^3$ as shown in Fig. 1. The Left Wall surface is made of brick and plasterboard with wooden doors every 3 m but in order to simplify the simulation procedure we assume the surface as a uniform wall made of brick and plasterboard with its dielectric characteristics given in Fig. 1. Furthermore, all the material characteristics are provided as well as the propagation geometry and the terminal positions. The beginning and the end of the corridor are open areas (very large spaces) and are not taken into account.

B. Multi-Ray Model

The multi-ray model is a general case of the two-ray model [4,5] for more than two reflected components. The reflected components may exhibit single or double reflection from a plane surface. Third or fourth order reflections, especially at 60 GHz, are negligible contributors to the average power and are not taken into account.

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