

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.

Indoor Channel Modeling At 60 Ghz For Wireless Lan

O García

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60GHz Technology for Gbps WLAN and WPAN Su-Khiong Yong, Pengfei Xia, Alberto Valdes-Garcia, 2011-08-02 This book addresses 60 GHz technology for Gbps WLAN and WPAN from theory to practice covering key aspects for successful deployment In this book the authors focus specifically on 60 GHz wireless technology which has emerged as the most promising candidate for multi gigabit wireless indoor communication systems 60 GHz technology offers various advantages over current or existing communications systems e g huge unlicensed bandwidth worldwide high transmit power high frequency reuse and small form factor which enables many disruptive applications that are otherwise difficult if not impossible to be realized at lower frequencies The book addresses all aspects of the state of the art in 60 GHz technology for high data rate wireless applications Key Features Comprehensive coverage from theory to practice provides readers with a thorough technical guide of 60 GHz technology development Brings together the entire area of 60GHz technology for Gigabits per second Gbps WLAN and WPAN applications Discusses practical system designs covering wide aspects such as antenna propagation beamforming circuit design digital communication signal processing system architectures etc Provides up to date standardization activities regulatory issues technology development as well as future trends Includes examples and case studies for practical scenarios Contains theoretical simulation and experimental results to demonstrate and compare the performance of various schemes or systems This book serves as an excellent reference for system engineers system architects IC designers standard engineers researchers and vendor and manufacturer consumers Technical consultants software and application developers will also find this book of interest

New Directions in Wireless Communications Systems Athanasios G. Kanatas, Konstantina S. Nikita, Panagiotis (Takis) Mathiopoulos, 2017-10-16 Beyond 2020 wireless communication systems will have to support more than 1 000 times the traffic volume of today s systems This extremely high traffic load is a major issue faced by 5G designers and researchers This challenge will be met by a combination of parallel techniques that will use more spectrum more flexibly realize higher spectral efficiency and densify cells Novel techniques and paradigms must be developed to meet these goals The book addresses diverse key point issues of next generation wireless communications systems and identifies promising solutions The book s core is concentrated to techniques and methods belonging to what is generally called radio access network

Theoretical Aspects of Spatial-Temporal Modeling Gareth William Peters, Tomoko Matsui, 2015-12-24 This book provides a modern introductory tutorial on specialized theoretical aspects of spatial and temporal modeling The areas covered involve a range of topics which reflect the diversity of this domain of research across a number of quantitative disciplines For instance the first chapter provides up to date coverage of particle association measures that underpin the theoretical properties of recently developed random set methods in space and time otherwise known as the class of probability hypothesis density framework PHD filters The second chapter gives an overview of recent advances in Monte Carlo methods for Bayesian filtering in high dimensional

spaces In particular the chapter explains how one may extend classical sequential Monte Carlo methods for filtering and static inference problems to high dimensions and big data applications The third chapter presents an overview of generalized families of processes that extend the class of Gaussian process models to heavy tailed families known as alpha stable processes In particular it covers aspects of characterization via the spectral measure of heavy tailed distributions and then provides an overview of their applications in wireless communications channel modeling The final chapter concludes with an overview of analysis for probabilistic spatial percolation methods that are relevant in the modeling of graphical networks and connectivity applications in sensor networks which also incorporate stochastic geometry features

Information Technology and Mobile Communication Vinu V Das, Gylson Thomas, Ford Lumban Gaol, 2011-04-13 This book constitutes the refereed proceedings of the International Conference on Advances in Information Technology and Mobile Communication AIM 2011 held at Nagpur India in April 2011 The 31 revised full papers presented together with 27 short papers and 34 poster papers were carefully reviewed and selected from 313 submissions The papers cover all current issues in theory practices and applications of Information Technology Computer and Mobile Communication Technology and related topics **The ...**

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