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MODELS FOR UWB PROPAGATION CHANNELS - A TUTORIAL

Andreas F. Molisch

Mitsubishi Electric Research Labs, Cambridge, MA, USA, and also at
Department of Electroscience, Lund University, Lund, Sweden.

Email: Andreas.Molisch@ieee.org

Abstract. We discuss models for ultrawideband propagation channels. In contrast to conventional channels, a UWB channel extends over such a large bandwidth that the propagation conditions for the different frequency components can be markedly different. There is also a much better temporal resolution of multipath components, which leads to a breakdown of the usual assumption of Rayleigh fading. This paper presents an overview of existing models, discusses their strengths and weaknesses, and points out directions for future research in that area.

Keywords. ultrawideband, propagation, delay dispersion

1 Introduction

Ultra-wideband (UWB) systems are often defined as systems that have a relative bandwidth larger than 20% and/or and absolute bandwidth of more than 500 MHz. Both large relative and large absolute bandwidth lead to a lessening of the fading [1], [2], and thus to more reliable communications. Furthermore, the spreading of the information over a very large bandwidth decreases the spectral density, thus reducing the interference to other systems, and making the intercepting of communications more difficult. Due to all these reasons, UWB systems have created tremendous commercial, as well as academic, interest.

UWB radars have been used in military applications for several decades [3], but UWB communications applications were introduced only in the early 1990s. Win and Scholtz [4], [5], [6] pioneered this field, introducing the concept of time-hopping impulse radio (IR), where the information is transmitted as a sequence of short pulses. Interest first concentrated on *military* applications, related to the possibility of stealthy and "through-wall" communications. Then, in 2002, the Federal Communications Commission (FCC), the frequency regulator in the USA, allowed the use of *unlicensed* UWB communications [7]. This created an enormous interest for *commercial* applications, both for high data rates ($>$ 100 Mbit/s), and for low data rates