Chapter 15
Different Aspects of Interleaving Techniques in Wireless Communication

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ABSTRACT

This chapter describes the use of certain interleavers for use in a wireless communication set for better accuracy and constancy of the transmitted data. Different interleaver techniques and methods are explored, including the variation of associated system parameters. The performance derived is discussed and the most suitable design is ascertained which is essential for better reliability of a wireless communication system. Bit Error Rate (BER), computational time, mutual information and correlation are the parameters analysed, in case of four types of interleavers viz. general block interleaver, matrix interleaver, random interleaver and convolutional interleaver, considering a fading environment. The hardware implementation using a block interleaver is reported here as a part of this work that shows encouraging results and maybe considered to be a part of a communication system with appropriate modifications.

INTRODUCTION

The development of wireless communication is at such a great pace in this century that it becomes an indispensable part of day-to-day life. Wireless communication is one of the fastest growing industries nowadays. From the onset of the 20th century, technology has been uprising at a remarkable note to provide new techniques and products for wireless communications. Wireless communication services are penetrating into our lives with an explosive growth rate. Most of the handheld and portable electronics

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we use in our day to day life such as cell phone, television, internet, etc. are all contributions of wireless communication. It has been a boon to the mankind, without which we cannot imagine a single day.

Multiple access is one of the key techniques in wireless communication system, especially, in the cellular mobile communication systems. In the recent years, the demand for bandwidth has increased fast. Since the demand for bandwidth is increasing, the information received at the destination should be as close as possible to the transmitted information from the source. It is very important that wireless channels are accurately simulated for designing and evaluating the performance of wireless communication systems. Therefore, different techniques have been proposed to meet the desired bandwidth requirement by trying to increase the spectral efficiency. But, in a wireless environment, when a signal is transmitted, it is subjected to reflection, diffraction and scattering due to the presence of obstacles like mountains, buildings, etc. in the medium. Because of this multipath behaviour, the signal received at the receiver have fluctuated amplitude, phase or multipath delay. This fluctuation of amplitude or phase in the received signal is known as signal fading. Hence, it can be said that the main cause of fading is multipath propagation. As the reliability and fidelity of transmitted data is always a matter of concern, there have been continuous efforts to achieve appreciable performance over different wireless media. Several techniques have been proposed and implemented to achieve such a goal. Interleaving is one of the simplest and convenient techniques which can be used efficiently in wireless applications. It has found its application for minimizing burst errors that creeps up in transmission. Thus, interleavers (Andrews, Heegard & Kozen, 1997) are used which provides a reliable transmission of data.

BACKGROUND

From the history of wireless communication, we see that wireless communication is that area of technology which has witnessed an explosive growth over a century. The basic question related with this technology is; how to send a message over the air medium? However, the solution to this question was given by Guglielmo Marconi in 1897, when he invented the radio through which people were able to communicate. After the invention of the radio, another question was raised; what is the best way to send a message across a noisy channel? Since then, many efforts are being taken to improve the performance over a noisy channel. These efforts has led to the birth of many new concepts in the field of wireless communication technology such as digital communication, channel estimation, channel allocation, signal processing for communications, encryption, decryption etc. In the 1940s, one of the important areas of wireless technology called *error correcting codes* was introduced, which deal with the corrupted information in a noisy channel. Before introduction of the error correcting codes, error detection codes were used to detect errors but the only way to correct the corrupted information was to repeat the transmission. The retransmission of information is not fruitful enough and sometimes it becomes unacceptable for many applications, since it does not guarantee a correct transmission (Asghar, 2010).

Claude Elwood Shannon demonstrated the theory of coding known as “coding theory” which says that the effect of errors and noise that are induced by a channel into the system can be minimized without affecting the information transfer rate, if the message bits are properly encoded. The coding theory describes the optimal design of a communication system. The main objective of the theory was to transmit maximum possible amount of information over a noisy channel, and detect and correct the errors that occurs due to noise. Shannon proved that there are good chances for information to transmit safely with the existence of a noisy channel, by properly encoding the message before transmission. The