Research Issues in Wireless

Communications and Networking

Farhat Anwar
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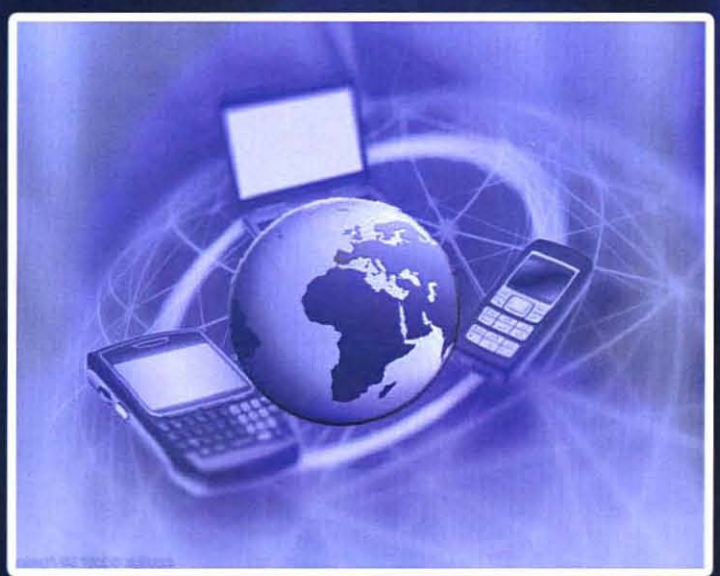

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Chapter 2

Design and Implementation of Loosely Synchronous Code Generator for MIMO Channel Sounder

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2.1 INTRODUCTION

MIMO (multiple input multiple output) wireless communication system is an innovative solution to improve the bandwidth efficiency by exploiting multipath-richness of the propagation environment [1]. The degree of multipath-richness of the channel will determine the capacity gain attainable by MIMO deployment. Therefore, it is very important to have accurate knowledge of the propagation environment/radio channel before MIMO deployment.

Knowledge of the radio channel is usually obtained via measurement or channel sounding. One type of channel sounding is using CDM that allows accurate measurement at the cost of hardware complexity. CDM channel sounder, requires code with excellent auto-correlation and cross-correlation properties which generally difficult to achieve simultaneously [2, 3]. In this research, we will study the characteristics of codes with good correlation properties and implement it in hardware as part of a larger project to develop CDM 2x2 MIMO channel sounder.

This chapter aims to discuss the design of hardware efficient code generator and that can be easily integrated into CDM 2x2 MIMO channel sounder system.

The conventional Time Division Multiplexing (TDM) MIMO channel measurement has the major drawback that absolute time synchronization and excess time slots are needed, considering that each channel uses its own time slot. In other words, the required time slots depend on the number of transmit nodes. As another approach, CDM MIMO channel sounder with low correlation codes. However, it also has disadvantage that dynamic range is limited by the number of transmit nodes due to none-zero correlation values. In this research, we propose new efficient CDM MIMO channel sounding technique with loosely synchronous (LS) codes and Kasami codes.

Loosely Synchronous (LS) sequence can be applied for CDM based channel sounder by its perfect zero-correlation property in a specific situation. To enhance the system performance, LS code sequence can be applied to deal with the problem that the interference free window (IFW) zone decreases as the number of codes increases. As LS code has the time delay region, which has no interference. This area calls interference free window (IFW). If any delay signal or a signal using other code from the same code set is within this region, we can investigate perfectly know the delay time and channel gain. LS sequence is generated by inserting all zero sequences between Golay complementary pair C and S which are binary sequence.

By using Verilog tools and software, the required design for the design code sequence generator for 2x2 MIMO channel sounder could be made. The specific software for this purpose is Xilinx ISE, Code Composer Studio (CCS) and 3L Diamond. The proposed design will be implemented into an FPGA device which represents LS codes and Kasami Code sequence generator for 2x2 MIMO channel sounder. The new sequence generator would be designed, implemented and tested step by step throughout the whole chapter.