CHAPTER 1
INTRODUCTION

1.1 Motivation

Multimedia communications has developed rapidly for last decades. As multimedia communications become increasingly popular, mobile communications are expected to reliably support high data rate transmissions. In this way, many improvements have been made during these past years through several generations of mobile communication systems.

Recently, the 3rd Generation Partnership Project (3GPP) has reached a mature state in the specification of Long Term Evolution (LTE) standardization. This new standard, also known as the fourth generation of mobile network systems, allows the use of a couple of new technologies which give the opportunity to have high capabilities compared to previous generations. Since the end of 2009, LTE mobile communication systems started to be deployed as the next generation of mobile communication. It is considered as a natural evolution of previous generations known as Global System for Mobile communications (GSM) and Universal Mobile Telecommunications System (UMTS).

One of the common feature of LTE is the using of MIMO (Multiple Input Multiple Output) antennas. MIMO is the use of multiple antennas at both the transmitter and receiver to improve communication performance. MIMO can be sub-divided into three main categories, precoding, spatial multiplexing or SM, and diversity coding. Precoding is a generalization of beamforming to support multi-layer transmission in multi-antenna wireless communications. In conventional single-layer beamforming, the same signal is emitted from each of the transmit antennas with appropriate weighting such that the signal power is maximized at the receiver output. When the receiver has multiple antennas, single-layer beamforming cannot simultaneously maximize the signal level at all of the receive antennas. Thus, in order to maximize the throughput in multiple receive antenna systems, multi-layer beamforming is required.

The previous work has built LTE encoder system for 2x2 MIMO antennas, but it has no precoder system yet. This Final Project is expected to complete the precoding system of LTE by using linear precoding method which is completed

by the use of codebook matrix. The precoder will be built in VHDL language and will be implemented on FPGA board.

1.2 Problem Formulation

The problem formulation for this Final Project are:

1. Designing LTE precoder with VHDL
2. LTE precoder implementation on FPGA
3. Testing and checking the result of designed LTE precoder implementation on FPGA.

1.3 Objectives

The objective of this Final Project is to design a LTE precoding system in VHDL and implement it on FPGA which includes:

1. Simulation of linear precoding LTE.
2. The implementation of linear precoding in digital circuit and determining the resources utilization included CLB, Slice, and DSP48.
3. The analysis of data rate in linear precoder system.

1.4 Scope of Work

1. Baseband level system.
2. This ungraduated thesis is focused on LTE Precoder designing.
3. The design will only be including transmitter part of LTE
4. The Final Project is using the 6th Transmission Mode of LTE which is specified for slow moving user (0-10 km/hour velocity).
5. Perfect syncronization is assumed.
6. Using FPGA hardware for Xilinx Virtex XC4VLX25-SF363.
7. The validation of designed system will be using Isim of Xilinx software and Microfsoft Excel 2007.

1.5 Methodology

This Final Project is arranged by following method:

1. Literature studies by collecting information about precoder LTE from relevan journals, books, articles, and other references.
2. System planning including the making of system design, building the system design, and doing the implementation of the design result.
3. Bulding the architecture design on VHDL using Xilinx software and verify the output using Matlab software.
4. Implementing the designed system on FPGA.

1.6 Outline of the Report

Chapter 1 Introduction

Introduction chapter will include the background, problem formulation, objectives, scope of work, and methodology of this Final Project.

Chapter 2 Literature of Review

This chapter describes the basic concept of the topics for this Final Project taken from books, academic journals, and other reliable resources.

Chapter 3 Design and Implementation of System

This chapter describes the architecture of the system in detail, including the modeling, the block diagrams, and the flowcharts of the designed system.

Chapter 4 Analysis and Implementation of Precoding System

This chapter describes the implementation process the designed system, the result of the implementation, and the analysis of the system implementation.

Chapter 5 Conclusion and Recommendation

This is the final chapter of this Final Project. The chapter describes the final conclution of the Final Project and the recommendation for future project.