Software implementation of the EWC standard for IEEE802.11n

Project Code: CR2-06

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Introduction

IEEE 802.11 family is the Wi-Fi standard commonly used in the world. 802.11n is the latest protocol in this family which can support up to 540Mbit/s theoretically. In order to increase the throughput, 802.11n builds from previous 802.11 standard by adding MIMO (multiple input multiple output) to increase the throughput. This project is focusing on the PHY layer of 802.11n. A software simulation platform will be developed which can simulate the different operation mode of 802.11n in a different channel model.

Aim and Objective

The aim of this project is to develop a MATLAB simulation module which can simulate the 802.11n PHY layer performance in different operation mode at a different channel model. At the end of project, a well organized MATLAB simulation package will be delivered.

Users can produce performance curve for analysis by using the simulation package. The simulation result can help users to understand the 802.11n standard and develop products related to 802.11n.

System block diagram

![System block diagram (Transmitter of 802.11n)]
**Implementation Phase**

There are three stages in the project to implement the system. The first stage is implement the software module, which was not implemented by the previous project group, and integrating the existing module to form a simulation platform. In this stage, the system can simulate the 802.11n communication without channel model, assuming there is perfect synchronization.

The second stage is adding different channel models to the simulation platform, such that the system can give the performance graph in different channels. Using the simulation result, the suitable operation mode in 802.11n in each channel can be found.

**QAM mapper and demapper**

![Decision region of 16QAM b0](image)

Because soft decision viterbi decoding is performed at the receiver side, the QAM demapper has to provide soft output bit-metrics for the viterbi decoder. The soft-output demapper proposed in [6] was adopted. The proposed algorithm approximates the bit-metrics based on Log-Likelihood Ratio (LLR) algorithm.

The grey code mapping allows the received bits to be demapped into two subsets. One is in I-phase and one is in Q-phase. For example of 16 QAM, the 4 bits, $b_0 \ b_1 \ b_2 \ b_3$, of the symbol can be two groups. $b_0$ and $b_1$ in $B_I$ group. $b_2$ and $b_3$ in $B_Q$ group.

![Decision region of 16QAM b1](image)
Simulation Result

The simulation software setting is defined as 10000 packets were transmitted and 1000 bytes for each packet. MMSE without VBLAST detection were used in the receiver side.

The 802.11n performance simulation for AWGN includes:
- Interleaving,
- Convolutional code
- QAM modulation
- STC
- OFDM subcarrier mapping.

![MCS 0 – 7 AWGN performance](image)

The 802.11n performance simulation for Channel B includes:
- Interleaving,
- Convolutional code
- QAM modulation
- STC
- OFDM subcarrier mapping.

![Channel B NLOS MCS 8 (2x2)](image)