

Design and Experimental Evaluation of Multi-User Beamforming in Wireless LANs *

Hua Yen Tseng
Department of Computer
Science and Information
Engineering
beyond1613@gmail.com

Brian Chen Department of
Computer Science and
Information Engineering
brian271828@gmail.com

Chang Ning Tsai
Department of Computer
Science and Information
Engineering
r01944032@ntu.edu.tw

Harry Chang
Department of Computer
Science and Information
Engineering
harrys86016@gmail.com

Lynda Lin
Department of Computer
Science and Information
Engineering
b99902065@ntu.edu.tw

ABSTRACT

In this final project, we will use USRP to implement Zero-Forcing Beamforming which allow mutli-antenna AP to send packets to multiple single-antenna client simultaneously. Multi-User MIMO promise to increase the spectral efficient of current wireless system. We will experiment whether Zero-Forcing Beamforming can increase throughput in multiple user environment than TDMA technique.

Categories and Subject Descriptors

C.2.1 [Computer-Communication Networks]: Network Architecture and Design—*Wireless Communication*

General Terms

Measurement, Performance, Reliability, Experimentation, Design

Keywords

Multi-User MIMO, Beamforming, Wireless LAN, Channel Information, Mobility, Interference Suppression

1. INTRODUCTION

Most of APs have multi-antenna to increase throughput. Currently, most wireless system implement Multiple-Input Multiple-Output(MIMO) for this purpose. Based on this concept, we want to experiment whether the throughput for MIMO system can imporve or not. In tradition single user systems, one user is servered at a time. we using s time

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division multiple access (TDMA) to solve multiple user in the environment. Therefore, TDMA has low throughput for multiple users' environments. We do not like such thing, because there are a lot of scenarios show that a great number of people in some place which is servered for some APs. We would not like to see that people go on internet slow.

In class,Kate Ching-Ju Lin introduce *Zero Forcing Beamforming* technique in current MIMO system. We are interesting in this technique. In our final project, we will use USRP to experiment the MIMO multiple-users system. we will evaluate the technique how much throughput does this system increase and what benefit for the MIMO system. Our implement is based on [1] and class lecture note.

1.1 mathematical model

We know that channel matrix is

$$y = Hx + n$$

and

$$y = \begin{pmatrix} y_1 \\ y_2 \\ \vdots \\ y_n \end{pmatrix}$$

$$H = \begin{pmatrix} h_{11} & h_{12} & \dots & h_{1n} \\ \vdots & \vdots & \dots & \vdots \\ h_{m1} & h_{m2} & \dots & h_{mn} \end{pmatrix}$$

$$x = \begin{pmatrix} x_1 \\ x_2 \\ \vdots \\ x_m \end{pmatrix}$$

We using Zero-Forcing to solve the equation. Assume that we have only two antenna for transmitter y_1, y_2 and reciver x_1, x_2 , and we compute x_1

$$y_1 h_{22} - y_2 h_{21} = (h_{11} h_{22} - h_{12} h_{21}) x_1$$

then

$$x_1 = \frac{y_1 h_{22} - y_2 h_{21}}{h_{11} h_{22} - h_{12} h_{21}}$$

Finally, we using successive interference cancellation to solve rest of variable x_k . Since our secnario have multi-users, we want interference nulling between antennas. Therefore, we solve the below equation

$$y = HWPx + n$$

Let

$$W = H^*(HH^*)^{-1}$$

Then

$$y = Px + n$$

2. ADDITIONAL AUTHORS

3. REFERENCES

- [1] E. Aryafar, N. Anand, T. Saloniadis, and E. W. Knightly. Design and experimental evaluation of multi-user beamforming in wireless lans. In *Proceedings of the sixteenth annual international conference on Mobile computing and networking*, pages 197–208. ACM, 2010.