Challenges in Building MIMO Testbeds

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Abstract

The paper provides the overview of wireless MIMOtestbed using HSDPA transmission protocol will also discuss the pros and cons of the MATLAB (stimulation tool) available in market .The paper reports the implementation of MIMO Testbed and some important measurement which will enhance the quality of network services

1. INTRODUCTION

Wireless testbed has gained lot of interest in telecommunication industry in the ever growing market of telecommunication designing a network has become a critical part to make right decision. The network setup requires lots of capital instrument hence there is always risk of failure. Thus testing a network and the network parameter is very important to avoid losses.

Testbed support real time data transmission over air experimentally the intermediate physical channels. It provides the exact stimulation of the network which is very realistic. Testbed provide the detail answers about the communication strategies.

The paper is organized as follows. The section2 provide the overview of stimulation tools used for building the testbed. In section 3 will provide the information about the transmission protocol (HSPDA). Section 4 will give the information about all result of the implemented testbed. Section 5 gives the conclusion and ends the paper.

2. MIMO TESTBED

MIMO (multiple input multiple output) uses multiple transmitting antennas and multiple receiving antennas.

The MIMO network improves the network performance by spreading the data access the different antennas which will also reduce the power consumption and improves the reliability and spectral efficiency of wireless network.
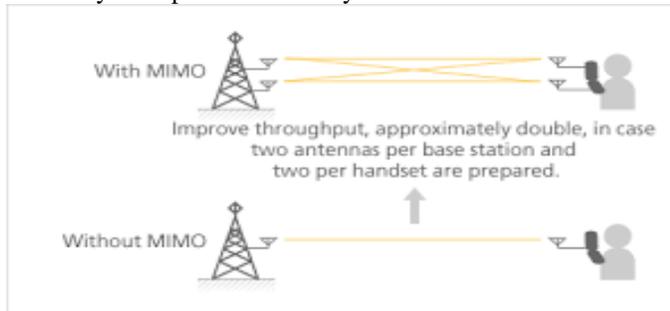

Fig1: Difference between MIMO and older technologies

Implementing the MIMO wires network has lot of financial investment,thus testing the network before implementing is very important to avoid the risk of network failure.

It is found that the signal can take multiple paths between the transmitter and the receiver.Previous these multiplepaths only served to introduce and interference of signals but using MIMO these additional paths can server as an advantage as it provides robustness.The two main advantages are spatial diversity and Spatial Multiplicity.

- Spatial diversity

In spatial diversity number of antennas are employed at the transmitter and at the receiver with minimum separation of $\lambda \backslash 2$ between them .In spatial diversity cannot increase the data rate But these could be achieved by using spatial Multiplexing.
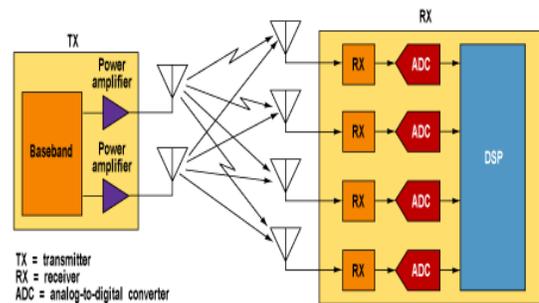
4. In a typical MIMO arrangement, two transmitters simultaneously send data on the same channel while four antennas on the receiving end are set in a spatial diversity arrangement.

Fig2: Spatial Diversity

- Spatial multiplexing

In spatial multiplexing the data is divided into different streams and the streams are transmitted independently through different antennas.Thesignals thatarrive at the receiver end with sufficiently different signatures .The receiver can separate the streams into parallel channels thus collaborating the data.
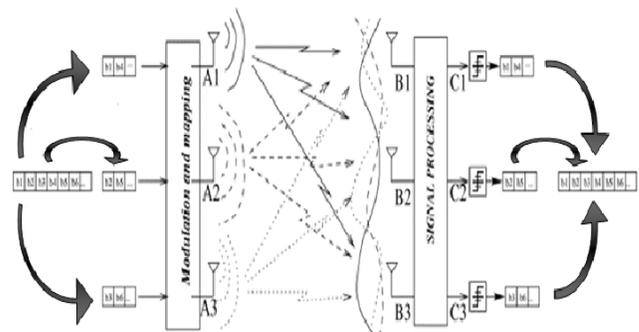
Fig3: Spatial Multiplexing

The advantage of MIMO technology over other previous technology is that MIMO based wireless networks are increased range,throughput and robustness of data link.It has ability to provide high data rate and increase the available bandwidth.

MATLAB is the stimulation tool available in market which will stimulate the network and the transmitting channels.

Testbeds actively collaborate with the MATLAB stimulation tool and can be used directly with MATLAB interface tool. These testbeds are advisable for beginners of MIMO transmission.

Assembling up a tested requires lot of capital, labor and time, but still it can be considered as cheap compared to the actual implementation of the network. If the tested is well structured and property working it may provide you the measurement in few minutes, exclusively when the data as processed down in tool like MATLAB.

2.1 From MATLAB code to testbed

If the matlab code proper work in the stimulation testbed can analyzed whether the algorithm are properly satisfies our air communication MATLAB CODE are saved with '.m' file extension. We can write the code in matlab programming editor for the systematic arrangement of code we combine related matlab functions in asingle stimulated block.

- E.g. A Signalprocessingblockscould applymultiple filters and smoothing algorithms to single block.
- E.g.data analysis block could find multiple metric to asingle block
- E.g.camera block could compare" all steps for acquisition and processing of data coming from camera.

3.   PROBLEM STATEMENT

Werequire lot of capital for setting up a network without any assurance of success.Thus testing a network before setting it up is very important. Thesolution to this problem is stimulate the network for testing purpose analyses the measurement and reliability of the network if it gives satisfactory results one can think ok implementation the network which we will test is multiple input multiple output MIMO with wireless communication HSDPA protocol. HSDPA is high speed downlink packet access which is a 3G mobile communication protocol. High data rate and throughput can be achieved using HSDPA.

3.1 HSDPA Architecture

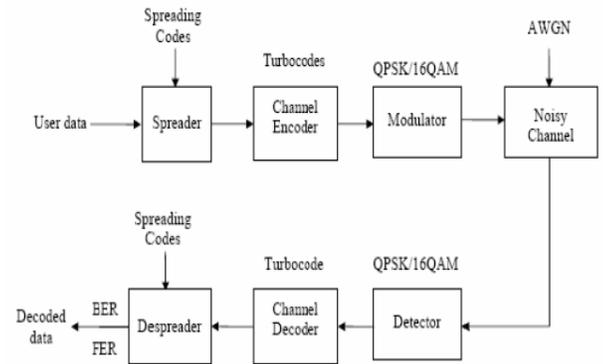The following figure represents the block diagram of HSDPA architecture

Fig4: HSDPA Architecture

- Spreader

Frequency of the signal transmitted is varied deliberately with spread spectrum. The output of the spreader is the signal with much high bandwidth.

- Channel encoder

The data transmitted through the channel should be encoded for the unauthorized access and secure transmission .The algorithm used for encoding is linear block code.Theoutputof the LBC is referred to as the codeword which contains the message and additional syndrome bit attached with the message.

- Modulation

Modulation is the process of changing one or more properties of the data signal. QAM Quadrature amplitude modulation is widely used in wireless data communication application.

- Noisy channel

Noise gets added in the signal when it is transferred inair.Thus while simulating network we add noise to the signal contaminatingit.The AWGN (additive white Gaussian noise)is added to the signal.It is the basic noise modes used to mimic the effect of many random processes that occur in nature .The signal is then decoded at the receivers end.The bit error ratio,throughput and other parameter are studied at the receiver end.

4.   RESULT AND OBSERVATIONS

Afterthe simulation done in MATLAB. We have measured three values , that is SNR, BER and PAPR. Basically we had made a graph of SNR vs. BER.

SNR stands for sound to noise ratio. It calculates the ration of desired signal to the background signal . Basically in stimulation while we are passing some sort of signal, background noise gets added to it. Hence in order to get the actual signal passed, we measure SNR. SNR is

IJISET - International Journal of Innovative Science, Engineering & Technology, Vol. 2 Issue 3, March 2015.

www.ijiset.com

ISSN 2348 – 7968

basically used for electrical signal. BER means bit error rate. It is the number of bits passed and received over a channel that have been distributed by noise and different errors. It is basically the ratio of mostly calculated in percentage (%). BER gets affected by distortion bits synchronization problems, signal attenuation, wireless multiple paths, signal fading etc.

As we are using OFDM based multicarrier modulation system, the interference is not constant and also the channel bandwidth is wide over the whole band. There are very much chances of getting variation of spectral content of the OFDM sub carriers. And hence the most useful unit for the evaluation of the performance of communication is BER and SNR indicates reliability between the transmitter and receiver. After plotting the graph for SNR vs. BER. We have observed that in the OFDM channel estimation as the SNR is increased to a greater extend with decrease in stimulation bit (BER). And to this we are using QAM because if we use PSK then the BER increased to larger extend
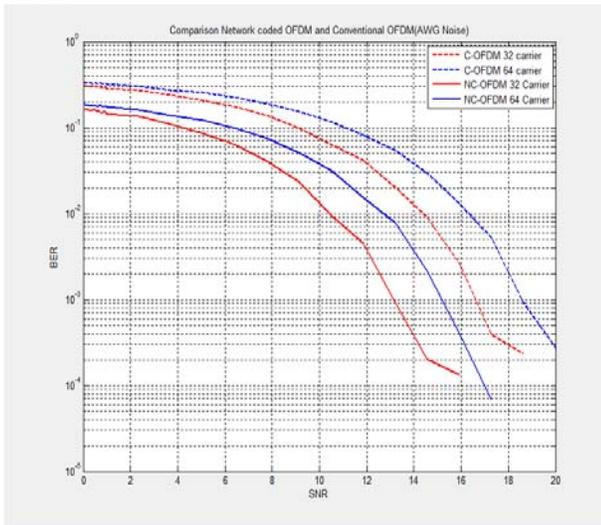

Fig5. SNR vs. BER graph

After coding in MATLAB we can now estimate through the graph that as the value of SNR increases BER value constantly decreases making the system more efficient. PAPR stands for peak to average power ratio . Crest factor is basically a measure of waveform. It shows ratio of peak value to the efficient value. It basically shows how extreme the peaks are in waveform. If the crest is 1 it shows that there are no peaks.

$$QAM = 1/\sqrt{3} = 0.57 \text{ RMS value}$$
$$QAM = \sqrt{3} = 1.732 \text{ Crest value.}$$
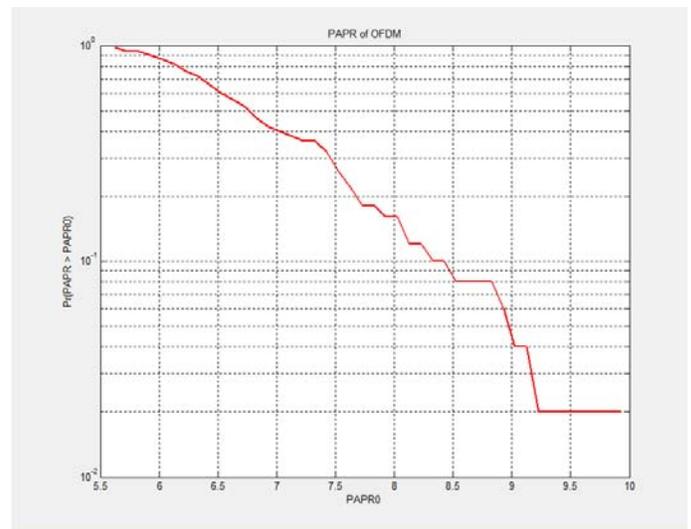$$QAM = 4.8db \text{ [PAPR]}$$

Fig6. PAPR graph

5. CONCLUSION

The paper all about the results and observations we made while building MIMO network. The stimulation is the better solution that can be implemented before setting up any network. The parameter for the HSDPA MIMO networks are recorded and studied which will improve the performance of the wireless network.

6. REFERENCES

- [1] Vienna University of Technology Institute of Communications &Radio-Frequency Engineering Gusshausstrasse,Austria.
- [2] Khan Sohaib, Nguyen Kim Cuong and Jörgen Nordberg School of Engineering, Department of Applied Signal Processing Blekinge Institute of Technology.
- S. Caban, C. Mehlf`uhrer, R. Langwieser, A. L. Scholtz, and M. Rupp, "Vienna MIMO testbed," EURASIP Journal on Applied Signal Processing.
- [4] SimonHaykins, "Digital Communications", John Wiley & Sons .