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THROUGHPUT ANALYSIS OF MOBILE WIMAX NETWORK UNDER MULTIPATH RICIAN FADING CHANNEL

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***Abstract* — The Mobile WiMAX simulation model is implemented by using MATLAB code. The simulation model consists of different phases which will help us to model the transmitter and receiver section. In the next phase, the data is being modulated by using the modulation methods QPSK and QAM followed by OFDM transmitter. These phases can be used to show the performance of these modulation methods under varying condition. The Multipath Rician fading model is implemented to introduce the fading in the transmitter data. Receiver section is used to receive data from channel will be fed into the OFDM demodulation. In the next phase, Fast Fourier Transform is used to disassemble OFDM frame. After that convolution encoding is applied to data and interleaving is carried on by using MATLAB function. BPSK method is used to change the data in the form of bit information to be symbols. We had used**

Different functions to modulate and demodulate data.

I. INTRODUCTION

A. What is WiMAX?

World Wide Interoperability for Micro Wave Access is the IEEE 802.16 standard, that specifies a frequency band in the range from 10 GHz to 66 GHz. Basically WiMAX is a wireless internet that's able to covering a wide geographic area by serving a vast selection of users at a very low cost. It particularizes a metropolitan area networking protocol which not only provides a wireless alternative for cable, Digital Subscriber Line (DSL) and T1 level services for last mile broadband access and also provides a backhaul for 802.11 hotspots and automobile higher data rates WiMAX is usually more established in cellular sector [1].

B. Multipath delay spread

The channel impulse response of a wireless channel looks like a compilation of pulses, due to the multipath reflections. The volume of pulses that may be eminent is very large, and depends on the time resolution of the communication or measurement system. So because of the non line of vision propagation nature of the WiMAX OFDM, we have to address multipath delay spread in this channel model. To handle the effect of multipath propagation, the delay spread parameter is employed. It depends on terrain, distance, antenna directivity and additional factors [3]. We can show a LOS and multipath scenario. It shows that at different time, multiple reflections of the same signal come to the receiver. This might result in an Inter symbol Interference (ISI) causing noticeable degradation in signal quality [2].

C. Fading Characteristics

In multipath fading, the received signal experiences variation in its amplitude, phase and angle of arrival in a multipath propagation environment. As a result they might add either constructively or destructively leading to a complex envelope. Small scale fading has also been addressed in this channel model due to the fixed deployment of transmit and receive antenna. If there is no line of vision signal component and there are multiple reflective paths that are large in number then small scale fading is termed Rayleigh fading [6]. When there is a line of vision component in conjunction with the multiple reflective paths then small scale fading is described by a Rician pdf, so in this channel model Rician distribution is used. The key component of this is the k factor that is the ratio of the direct component power and the scatter component power [5].

II. LITERATURE CITED

Lee et. al. [5] Here, all simulations are performed by using Matlab programs. At First, the 88 data bits are randomly generated for BPSK modulation. Next we use the function in Matlab named as rsenc (msg,N,K,varargin) to perform Reed-Solomon encoding with the output of 96 bits (8 code word bits). Later, the 96 bits are input of Viterbi (msg , template , Tx) in order to perform Convolution encoding. At this stage, the output of data stream is 192 bits. Next, the task of interleaving 192 bits is carried on by using intrlv (data, elements). Now, it is ready to change the data in form of bit information to be symbols. For BPSK, the number of bits is equal to the number of symbols. The function to modulate data is called as pskmod (x,M) in which pskdemod (x,M) is a function to demodulate signal.

Loutfi et.al. [7] The simulation result shown in this paper infers that mobile WiMAX system using Turbo coding provides BER of 10-5 at Eb/No of 14 dB which is better than LDPC coding by providing BER of 10-4 for QPSK modulation scheme in the presence of Rayleigh fading channel.

Ghosh et.al. The performance analysis of WiMAX 802.26e physical layer model, simulation is performed by considering the standard test vectors specified in the WIMAX standard. BER Verses SNR. BER is the number of error bits occurs within one second in transmitted signal. BER define mathematically as follow. When the transmitter and receiver's medium are good in a particular time and Signal-to-Noise Ratio is high, and then Bit Error rate is very low. In our thesis simulation we generated random signal when noise occurs after that we got the value of Bit error rate.

SNR= Signal Power/Noise Power
SNR= (Signal Amplitude/Noise Amplitude) 2

Khan et.al. [11] The WiMAX MAC (Medium Access Control) layer simulink model is used; we use AWGN (Additive White Gaussian Noise) and different modulation schemes used like QPSK (Quadrature Phase Shift Keying) and QAM (Quadrature Amplitude Modulation).

Chowdhury et.al. [8] The performance of WiMAX MAC layer is based on the simulation results. Mobile WiMAX system using LDPC coding and Turbo coding and MIMO model is simulated for different modulation schemes such as QPSK and 16-QAM under Rayleigh fading channel with the help of MATLAB.

Grewal et.al. [9] It is inferred that mobile WiMAX system using LDPC coding has BER of approximately 10-4 at 9 dB of Eb/No for QPSK modulation. But, the BER is approximately 10-4 at 13 dB of Eb/No for 16-QAM modulation under Rayleigh channel.

Neha et.al. [10] BER performance of Mobile WiMAX system using LDPC and Turbo coding is determined and compared for above mentioned modulation schemes in the presence of Rayleigh channel. Further, BER analysis of mobile WiMAX system using MIMO model with STBC and STTC is calculated as compared between STBC and STTC.

III. MATERIALS AND METHODS

A. WiMAX System Modelling Using Rician Fading Channel

The third variation in the modelling of WiMAX product is with the replacement of Rayleigh channel by Rician channel. For sub cities where there can be the prospects for realizing the line of vision path in conjunction with multipath structure, the wireless channel must be modeled as the Rician channel and that is again the real time realization of fading phenomenon of the wireless systems. In the modeling of the Rician channel the multipath variations of signal are superimposed over the line of sight component which increases the overall strength of the whole information at the receiver.[12]

Rician fading is characterized by a factor, which is expressed as the power ratio of the secular (los or dominant path) component to the diffused component. This ratio, k, defines how in close proximity to Rayleigh statistics the channel is. In fact when k=infinite, there isn't any and when k=0, this method for Rayleigh fading. The ratio is expressed linearly and not in decibels. While the Average path gain vector parameter manages the overall gain through the channel, the K-factor parameter controls the gain's partition into line-of-sight and diffuses components [4]. The other blocks and properties of WiMAX model will continue to be the same. [1]

B. Implementation

We have done the following for implementation and analysis:

In this semester, I had implemented the Mobile WIMAX simulation model by using Multipath Rician Fading Channel. The throughput of the model is being analysed and it is compared with the results already given for various other channels. Basic encoding and modulation method remain the same which had been used by other channels for the comparison. I had used MATLAB software to implement different functions related to this simulation model. Various parameters which can affect the throughput of the model are defined beforehand. Different metrics are chosen to perform the evaluation and results are represented in tabular and graphical from [7].

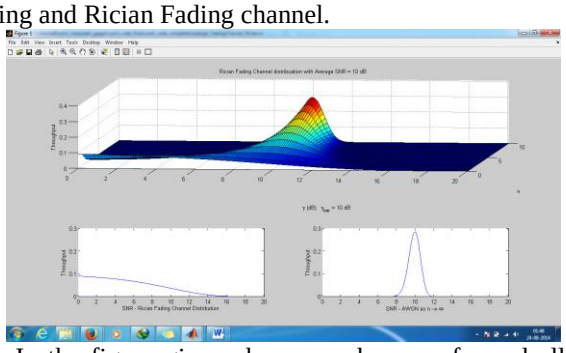
C. Methodology Used

The methodology which we have used to develop the WiMAX Modelling using ideal Rician Channel for the physical layer is given as follows:

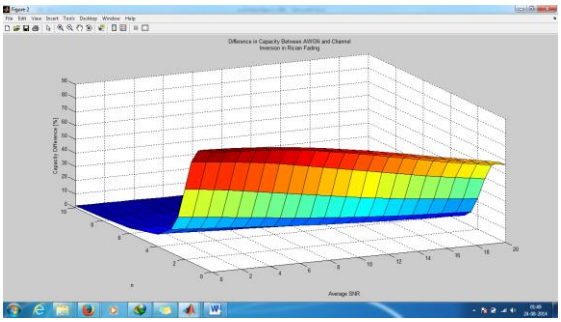
1. The first step which had been followed is to generate a random data stream of length 4400 bit which we have used as the input binary data. We have used Matlab 7 version in which data input of bits is done by using inbuilt function of the Matlab. We have used the random function which is used to divide and assemble the data so that it nis possible to convert long sequences of 0's or 1's in a random sequence. If the input is given in a proper way then it is possible to have better coding performance.
2. After the data is input then we have to check the errors in data. There are many inbuilt functions available In Matlab which can used for error checking. The encoded data after error checking is used to perform rated convolutional encoding. The interleaving function is applied on the encoding data.
3. Then various digital modulation techniques like QAM, 16-QAM and 64-QAM, are specified for WiMAX Physical layer so that we can say that it is used to modulate the encoded data.

IV. RESULTS AND DISCUSSION

In this part of the report, we will presents and discuss all of the results obtained by the computer simulation program written in Matlab7. We have analyzed the wireless communication system considering AWGN, Rayleigh Fading and Rician Fading channel.



In the figure given above, we have performed all the calculations with the synthetically generated data. The results are shown in terms of bit energy to noise power spectral density ratio (Eb/No) and bit error rate (BER) for original values of system parameters. By varying SNR, we have plotted Eb/No vs. BER by using the "semiology" function. The Bit Error Rate (BER) plot obtained in the performance analysis showed that simulator is valid for Signal to Noise Ratio (SNR) less than 25 dB.



Simulation results in figure above shows the performance of the system over AWGN and fading (Rayleigh & Rician) channels using modulation scheme. In this research work, it has been shown that the performance of an OFDM based WIMAX Communication system adopting different coding schemes and digital modulation scheme.

The performance of Rician fading channel is worse than that of AWGN channel and better than that of Rayleigh fading channel. Because Rician fading channel has higher BER than AWGN channel and lower than Rayleigh fading channel. BER of this channel has not been much affected by noise. The elapsed time taken for the implementation of the simulation is reduced as compared to other models. The path gain values for the Rician fading model are given foe certain points as well as a total value.

V. CONCLUSION

This thesis presents performance over MAC layer under various modulation schemes in Rician channel. A key performance way of measuring a wireless communication equipment is the SNR versus PER. It might be figured for a certain price of SNR at some signal power the performance in relation to BER is less in QAM system compared to a QPSK system.

To realize ideal conditions of propagation of WiMAX system, the modeling can be achieved by assuming the international calls highly efficient path i.e. AWGN channel. For understanding the real time multipath structure of WiMAX model, the channel is simulated as Rayleigh channel in worst scenario wherein the performance in terms of fading can be improved by changing the valuation on Doppler shift. With the same criterion, the presence of line of vision is usually justified by modeling WiMAX with Rician channel. Also the performance can be improved by implementing of antenna diversity techniques with BLAST and also STBC with fading channel scenario.

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