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Performance Enhancement of MIMO OFDM Communication System Using ADAPTIVE MODULATION AND CODING Technique: A Review

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Abstract: *Wireless communication is the most hot topic for the developers and it is most emerging area in today scenario because of its involvement in our daily life thus this is an important part of our daily life now because most of the technology we are using now are based on wireless communication. There are various transmission modes which are defined in LTE. But there are limited numbers of modes which we consider for the physical layer parameters and wireless channel features. Here we evaluate the permissible transmission modes in LTE. We also make the performance analysis of these transmission modes by evaluating the LTE. For computing the performance of transmission modes we calculate various factors like bit error ratio, signal to noise ratio in the most commonly used wireless networks which are AWGN, Rayleigh and Rician. There are some other factors which are considered while computing the performance like data modulation and data rates.*

Keywords:-*MIMO, QPSK, QAM, AWGN, fading, , antenna, BER, M-PSK.*

1. INTRODUCTION

The need of wireless network is the faster data rates which is possible by employing MIMO because in MIMO we use multiple antennas at the receiver and transmitter side which makes the data transmission much faster by spatial diversity. So MIMO systems are well-known in wireless communications for high data rates. [1] we can enhance the capacity of an wireless network by the increasing the number of antenna. There are basically two reasons due to which we are using wireless communication over the wired communication system. First one the multi path fading which means the change in signal strength due to the various factor like buildings, loss of path because of attenuation and shadowing [2]. The second benefit of wireless transmission is that in that the whole transmission media is in air and while in wired system the entire data is dependent on the transmission points which are at separate points. In MIMO system we are using multiple antennas which allow the spatial diversity by employing the multiple antennas in a narrow multipath fading medium that are situated at some distance. [3].The main feature of MIMO is diversity gain or capacity gain by which we can remove the fading of signal. The main idea behind the development of MIMO is to improve the signal quality and the data rates by using multiple transmitter and receiver antennas [4]. The basic element of MIMO is space time coding. There are two basic features of space time coding which are: diversity and multiplexing. To attain the maximum performance we have to maintain a relationship between the diversity and multiplexing.

In MIMO system there are various coding method which we are using these coding methods are the methods by which we can attain the desired data rates over the wireless transmission systems [5]. The main concern in these systems is the problems that we are facing while implementing these kind of systems. There are some recent examples of such system in which we use MIMO system like WiMAX, IEEE 802.11n and 3GPP LTE etc.

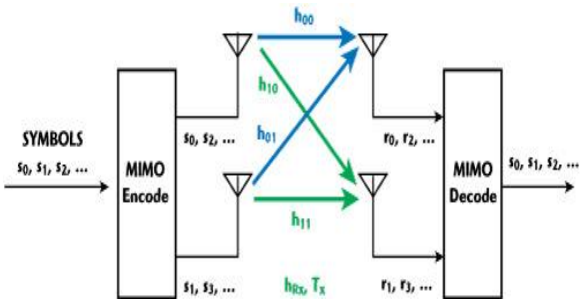

Figure 1: MIMO System (2X2 MIMO Channel)

2. LITERATURE SURVEY

Aliyu Buba Abdullahi et.al OFDM being an popular for the downlink on the newly generation LTE networks. The basic function of this is to divide the large range bandwidth into the various small range bandwidth which are being further utilized to carry the information and that takes the selective fading as the flat fading. As to use the OFDM in LTE networks we use it with the integration with the MIMO. Thus this integration helped to improves the data rates and to improve the network performance level.

Emmanuel Migabo et.al

As in LTE our main aim is to improve the data rates and thus this can be done by the help of using three different modulation schemes which are being used at the various channel conditions. These three modulation schemes which are being opted are QPSK, 16-QAM and 64-QAM. In this paper we gives an overview about the LTE communication networks system Simulink model, which is being used to determine the effect of the QPSK, 16-QAM and 64-QAM

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modulation schemes on the BER performance with an AWGN channel model. There are various subsystems in the transmitter and reliever which are being used in the Simulink.

Anjitha Viswanath et.al as there are being various parameters which are being effect the performance level of the networks. Atmospheric hindrance is one of them that cause the degradation in the free space optical communication links. There are various solutions are being designed to solve the problem of atmospheric hindrance among them aperture averaging is the most famous technique.by employing various experiments we analyze their effect of this technology over the network performance and then analyze this for the various FSO intensity modulation (1M) schemes namely on-off keying (OOK), pulse position modulation and differential pulse position modulation. While carrying the experiment we generate the artificial environment which resemble with the actual environment this turbulence is generated by the help of optical turbulence generator and thus for the above illustrated modulation scheme we analyze the performance of the network at various temperature conditions.

Swati Sharma et.al in this paper the author presents the comparative study among the various modulation techniques which are being used in the LTE networks like OFDM AWGN channel. , BPSK, QPSK, 16QAM and 64QAM, thus by this comparison we can get the best modulation scheme which is being best according to our parameters, bit error rate and signal noise ratio are the parameters on which we define the comparative nature of our modulation techniques.

Makarand N. Patil et.alin this paper the author gives an analysis of various modulation techniques on the basis of bit error ratio. There various schemes are used for the modulation like QPSK and BPSK. Thus among these modulation techniques we analyze its performance and select the best modulation technique on the basis of bit error rate (BER) is transmitted. After the selection of modulation technique for the simulation of network we use the MATLAB. In present paper the author gives an analysis about the wavelet based OFDM system. By plotting an performance curves we can analyze the various bit error rates for the various modulation techniques.

Leila Nasraoui et.al present a paper In which he discussed about the methods of synchronization in MIMO-OFDM system that use the space time coding and also present its use in IEEE 802.11 wireless network standards. The main aim behind this study is identification of starting phase and the fractional part of the frequency offset. For this method the Leila uses the method of Wang scheme. Here he analyze the correct detection rate and mean square error. In his paper he presents a method for the space time coding synchronization so that it may not need the channel estimation for the wireless networks.

A. I. Sulyman et.al presents an overview about the selection of antennas in the performance of the MIMO system on the non-linear communication channels. From the result we comes to know that as the number of antennas available at the receiver are reduce that the performance of the system also decreases because the non linearity of the channel, that show some saving at SNR which is due to the non-linearity for the reduced complex system.

C. Wang et.al presents a study about the MIMO system implementation in which he shows that by employing MIMO system we can increase the capacity without using any extra spectrum or without consuming much power. To attain the signal at the receiver in the MIMO system we use the zero forcing detection technique. In addition for this we also need the knowledge about the channel information, but for the practical use this is not possible to attain the CSI.

Gerhard Bauch et.al presents an analysis in which he discuss about the suitable orthogonal space-time block codes and space-frequency block codes in a 4G OFDM system. The main feature of such kind of space codes is that by employing these codes the data speed does not degrade even at the high speed of vehicle of the variation in signal, there are certain frequency selectivity that can limit the performance of space frequency block codes unless. Thus in broadband system we can exploit the frequency and spatial diversity by employing complex space time frequency codes.

Table 1: Literature Review Table

Reference	Authors	Research methodology used	Major findings	Research prospects
[1]	Aliyu Buba Abdullahi et.al	DLSCH downlink channel is used & a payload is generated. Cyclic Redundancy check is used for error detection. For code word generation sub block segmentation & rate matching is required.	SNR obtained for MIMO System 2×1 , 2×2, 4×1, 4×2, 2×4 is 16,15,20,17,16db respectively.	The system can be used for 5G operations. By increasing base station antenna overall system capacity is to be increased.
[2]	Emmanuel Migabo et.al	LTE Simulink model is design for BER calculations	Simulated bit error rate for 16 0.65 and 0.86	The performance analysis is divided into three parts. 1.Channel Coding

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				2. Reliability 3. Efficiency Performance is better than 16-QAM & 64-QAM
[3]	Anjitha Viswanath et.al	Two technique used 64 –PPM 64-DPPM Both techniques are controlled by electric heater & depend upon air flow	BER for 10^0 C tempt. 3.96×10^{-2} BER for 64-DPPM :3.86×10^{-4} 64-PPM : 5.82×10^{-5}	The overall system is used MPPM scheme instead of FSO link design
[4]	Swati Sharma et.al	BPSK , 4 bit QAM , 16 bit QAM is used for AWGN Channel	BPSK gives least error rate and with the increase in order of modulation, Bit error rate goes on increasing with SNR. 64 QAM has the maximum error rate.	The paper has concluded that higher is the order of digital modulation scheme more will be the bit error rate. But in LTE system more data rates are required which are only possible to be achieved with higher order of modulation.
[5]	Makarand N. Patil et.al	In OFDM, orthogonal basis functions are used as subcarrier. The complete information transmitted is obtain by receiver signal	BER Performance is improved as compared to conventional OFDM	Wavelet based OFDM are better as compare to DFT based OFDM
[6]	Leila Nasraoui et.al	Differential coding used for wireless local area network to improve synchronization.	Rayleigh Fading channel is used for synchronization	Technique can be applied to number of antennas more than two.
[7]	A. I. Sulyman et.al	Pair wise error probability (PWEP) performance of the reduced-complexity of space time coding system is proposed.	Antenna selection is a useful method to optimize the performance trade-offs in MIMO system.	Antenna selection on transmitter side can also be analyzed.
[8]	C. Wang et.al	SNR distribution is used to analyze BER performance.	Due to imperfect channel estimation when SNR is high, BER does not approach zero.	Channel estimation error should be minimized.
[9]	Gerhard Bauch et.al	BER analysis has been used to check code efficiency.	Space time frequency codes are more suitable than space-frequency block codes and have lower detection delay than space time codes.	Adaptation of channel can be made simpler.

3. CONSTELLATION DIAGRAM

LTE system with various evaluation metrics such as BER and SNR.Consider a complex tone signal:

$x(t) = e^{2\pi ft}$ with a period T. The peak value of the signal is:

$\max[x(t)x^*(t)] = \max[e^{2\pi ft}e^{-2\pi ft}] = \max[e^0] = 1$

The mean square value of the signal is: $E[x(t)x^*(t)] = E[e^{2\pi ft}e^{-2\pi ft}] = 1$

That provides a PAPR value of about 0 dB. Assume that an OFDM time signal has build by using K complex tones. Thus we can represent our signal by the following formula.

$$x(t) = \sum_0^{K-1} a_k e^{\frac{j2\pi kt}{T}}$$

to make calculations easier take a_k=1 for any *k*. thus by this the peak value of a signal becomes:

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$\max[x(t)x^*(t)] = \max\left[\sum_0^{K-1} a_k e^{\frac{j2\pi kt}{T}} \sum_0^{K-1} a_k * e^{\frac{-j2\pi kt}{T}}\right] = \max\left[a_k a_k * \sum_0^{k-1}\sum_0^{k-1} e^{\frac{j2\pi kt}{T}} e^{\frac{-j2\pi kt}{T}}\right] = K^2$

The mean square value of the signal is:

$E[x(t)x^*(t)] = E\left[\sum_0^{K-1} a_k e^{\frac{j2\pi kt}{T}} \sum_0^{K-1} a_k * e^{\frac{-j2\pi kt}{T}}\right] = E\left[a_k a_k * \sum_0^{k-1}\sum_0^{k-1} e^{\frac{j2\pi kt}{T}} e^{\frac{-j2\pi kt}{T}}\right] = K$

Constellation diagram of different modulation technique is given as

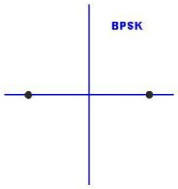

Figure 2: Constellation Diagram of BPSK [8]

The easiest kind of phase shift key is the binary phase shift key which is popularly known as BPSK. Here the value of N is 1 and for M its is 2 thus for a BPSK there are mainly two phases (21=2) are feasible for a carrier. In these two phases one phase have shows the value 1 and other shows the logic 0. As the binary input changes its value from 0 to 1 and 1 to 0 thus the phase of the output is also changes. This change occurs between the two angles which are separated by the angular distance 180°. Diagram for a BPSK model is shown below in fig 3.

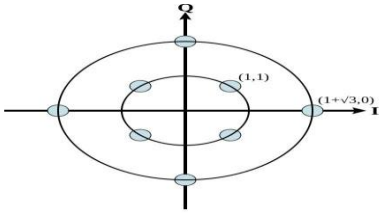

Figure 3: Constellation Diagram of 8 – QAM [8]

8-QAM as shown in fig above is a M-ary encoding technique where M = 8. As we studied in 8-PSK that the value for the amplitude at output is in constant from but in 8-QAM this is not constant. In thus the output comes from the I and Q channel are added in a linear summer and that generates a modulated output of the summer output =-0.541 sin _ct. -0.541 cos_ct. = 0.765 sin(cos - 135°). For the remaining tribit codes (001, 010, 0ll, 100, 101, 110, and 111), the procedure is the same. Constellations diagram of 8 –QAM is represented in fig 4.

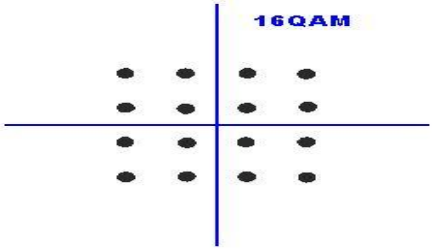

Figure 4: Constellation Diagram of 16 – QAM [8]

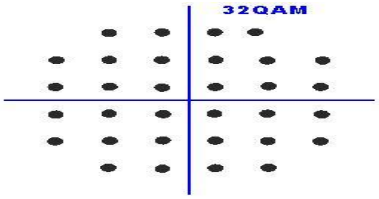

Figure 5: Constellation Diagram of 32 – QAM [8]

32 – QAM constellation is explained in the fig 5. There is 32 points each are 45°, 135° respectively.

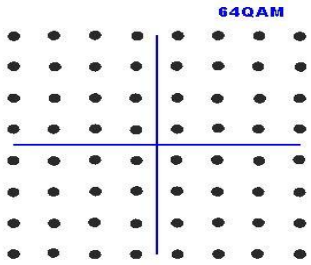

Figure 6: Constellation Diagram of 64 – QAM [8]

64 – QAM constellation is explained in the fig 6. There is 64 points. Each point is parallel aligning to each other.

4. CONCLUSION

In this paper we discuss about the MIMO-OFDM in which we use the multiple antennas which are being positioned at the various different locations, by using the MIMO system we can also have the opportunity to use the spatial diversity feature thus to prevent the channel fading which has the multiple paths which are not relate to each other. In this method the numerous copies of information is being transmitted from the receiver antenna in transmit diversity and that information is receive at the Rx antennas in receive diversity. By this we observe a special feature of the spatial diversity which is that in this we don't need to take much time or the frequency to get the diversity. The above reviewed work are concentrated on improving the throughput without focusing the energy utilization of the system. Since most equipment are operated on battery power which makes it difficult to improve the throughput and energy efficiency. In MIMO communication system, 30%–50% of the power is utilized from the total power consumption. The energy efficiency maximization will increases the time required for processing the system. Hence, it is considered as a challenging issue for improving the energy efficiency.

References

[1] Aliyu Buba Abdullahi "Performance Evaluation of MIMO System Using LTE Downlink Physical Layer" SAI Computing Conference, London, UK , pp 661-668, 2016.

[2] Emmanuel Migabo, Thomas Olwal "A Simulation Design of LTE Communication System under Adaptive Modulation Schemes" International

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INTERNATIONAL JOURNAL FOR ADVANCE RESEARCH IN ENGINEERING AND TECHNOLOGY

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Conference on Communication Systems and Networks (COMSNETS), pp 1-5, 2017.

[3] Anjitha Viswanath, V. K. Jain, Subratkar "Experimental evaluation of the effect of aperture averaging technique on the performance of free space optical communication link for different intensity modulation schemes" IEEE International Conference on Computational Intelligence and Computing Research (ICCIC) , pp 5-12 , 2016.

[4] Swati Sharma, Harjit Singh "Comparison of Different Digital Modulation Techniques in LTE System using OFDM AWGN Channel: A Review" International Journal of Computer Applications (0975 – 8887) Volume 143 , issue 3, pp 1-4 , June 2016.

[5] Makarand N. Patil , Prof. Dr. N. S. Nehe " BER Analysis of OFDM in LTE using Various Modulation Techniques " International Journal Of Innovative Research In Electrical, Electronics, Instrumentation And Control Engineering Vol. 4, Issue 5, pp 227-229 , May 2016.

[6] Leila Nasraoui et.al "Synchronization Technique for MIMO-OFDM WLAN Systems with Space Time Diversity", IEEE Trans. Communication, vol. 50, no. 5, pp. 250-254, May 2015.

[7] A. I. Sulyman, Performance of MIMO Systems With Antenna Selection Over Nonlinear Fading Channels, IEEE Journal of Selected Topics in Signal Processing, Vol. 2, Issue 2, pp. 159-170, April 2008.

[8] C. Wang et.al , On the Performance of the MIMO Zero-Forcing Receiver in the Presence of Channel Estimation Error, IEEE Transactions on Wireless Communications, Vol. 6, Issue 3, pp. 805 – 810, March 2007.

[9] Gerhard Bauch "Space-Time Block Codes Versus Space-Frequency Block Codes", IEEE journal of image processing, pp 567-571, Dec 2003,