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Computer-Based Analysis of The Performance of Different Modulation Techniques in Wcdmasystem Withdifferent Channels.

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ABSTRACT

The wideband code division multiple access (WCDMA) mobilewireless networks is among the lot of experiences digital communication has had for its tremendous growth. WCDMAnetworks are meant to provide a diverse amount/range of multimedia services tomobile users with assured quality of service (QoS). To achieve this, our report is dwelling mainly on the analysis of the performanceof Phase Shift Keying modulation(M-PSK)and M-Ary Pulse Amplitude Modulation (PAM)in WCDMA with different modulation channels,by comparing channel element like Bit Error Ratein RAYLEIGH fading and AWGN Channels using Matlab/Simulink. This research analysis will assist/enable us determine which modulation technique is performance effective in WCDMAsystem via any of these channelsat higher run time and M-Ary number.

Keywords: *M-PSK, M-Ary PAM, Bit Error Rate, WCDMA*

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I. INTRODUCTION

WCDMA (Wideband Code Division Multiple Access)is deployed in UMTS (Universal Mobile Telecommunication System) as the platform for 3G cellular network so as to providehigher data rate communication, which results in efficient transfer of video streams and pictures with high resolution to the end users at a faster rate. It hence becomes necessary to choose a suitable modulation technique to be used in WCDMA system (Omijeh and Udoh ,2015).

WCDMA applies the spread spectrum technique, where the transmissions are spread over a wide bandwidth of 5MHz. It has a peak data rate for uplink and downlink transmission of 384kbps unlike GSM, which has a peak data rate of 14.4kbps, and downlink speed of WCDMA is 2Mbps to GSM with a downlink speed of 384kbps. Because of higher data rate, WCDMA can cover more area with fewer towers. Hence, WCDMA is a better technology than GSM. However, with higher data rate of transmission and increase in the amount of users in the network, there is a higher probability of errors due to noise and interference of data in the channels. To combat these shortcomings, the system needs better modulators, demodulators, filters and a transmission path to incorporate an optimum modulation technique (Omijeh and Ehikhamenle,2015).Hence, in this paper we shall use ***Simulink*** to compare a few modulation techniques with two different channels in the WCDMA system to find out which is better, because with higher data rate of transmission and increase in the number of users in the network, there is a higher probability of errors due to noise and interference of data in the channels. This comparism in this research is with respect to BER, run time and M-Ary numbers.

II. THEORETICAL REVIEW

Bit Error Rate:

In the system of digital transmission, the number or amount of bit errors is the number of bits received from a data stream over a communication which has been manipulated due to interference,noise, distortion bit or synchronization errors. The BER gives the upper limit for the signal due to the fact that some degradation occurs at the end of the receiver (Omijeh and Agoye ,2015).

The bit error ratio or bit error rate(BER) is the bit errors number divided by the total number of bits transferred during a studied period interval. BER is a unit less performance measure, often expressed as a percentage.

The probability of bit error PE is the expectation value of the BER. The BER can be taken as an approximate estimate of the probability of bit error. In a channel with much noise, the BER is usually expressed as a function of the normalized carrier-to-noise ratio measure denoted E_b/N_0 (Tharakanatha et al, 2013).

Pulse Amplitude Modulation (M-Ary PAM)

Pulse-amplitude modulation (PAM) is a system of signal modulation in which the message information is encoded in the amplitude of a series of signal pulses (Vishwas, 2012; Rashmi, 2016). M-ary PAM is a one-dimensional signaling technique expressed as:

$$s_i(t) = A_i \cos 2\pi f_c t \quad i = 1,2,\dots M$$
$$= \sqrt{\frac{2E_i}{T}} \cos 2\pi f_c t \qquad (1)$$
$$= \sqrt{\frac{2E_o}{T}} \mathrm{a_i} \cos 2\pi f_c t$$
$$= a_i \sqrt{E_o}\,\psi(t)$$

Where the

$$\psi(t) = \sqrt{\frac{2}{T_b}} \cos 2\pi f_c t \qquad (2)$$

And, E_o is the energy of the signal with lowest amplitude.
The average symbol energy:

$$E_{av} = \frac{(M^2 - 1)}{3} E_o \qquad (3)$$

The probability of symbol error on AWGN channel:

$$\mathrm{P_{PAM}(e)} = \frac{(M-1)}{M} \mathrm{erfc}\left(\sqrt{\frac{3}{M^2-1}\frac{E_{\mathrm{av}}}{N_0}}\right) \qquad (4)$$

Phase Shift Keying (M-PSK)

In the communication industryPhase Shift Keying (PSK) is widely used. PSK is a large class of digital modulation systems. Here in this research book, we will discuss a few PSK modulation scheme and analyze the effectiveness of the schemes in 2 different channels with respect to BER (Saiful et al, 2015: Omijeh and Adabanya, 2015).

The BPSK is one of the simplest forms of Phase Shift Keying (PSK). The phase of the signal is being shifted and they are separated by an angle of 180 degrees and this is also known as 2-PSK. The Constellation diagram for BPSK is usually drawn on real axis 0°and 180°. This modulation scheme is more robust and best suites cases that provides secure communication [2]. Quadrature Phase Shift Keying **(QPSK)** adds 2 more phases; 90 and 270 degrees. Therefore 2 symbols per bit have the possibility of being transmitted (Ruchi et al, 2016).

Rayleigh Fading

Since the propagation of signal takes place in the atmosphere and close to the ground, asides the effect of free path loss, Ls, multipath propagation is the most common or notable effect of signal degradation. This particular effect can cause fluctuations in the amplitude of the received signal, phase and angle of arrival, resulting to the terminology multipath fading.Generally, two fading effects exist in mobile communications and they include: i) large-scale and, ii) small-scale fading (Ling, 1995).

The signal that is received consists of large number of multiple reflective paths and there is no line-of-sight signal component(Ling, 1995).

AWGN (Additive White Gaussian Noise)

For a communication system that is ideal, the communication channel is only anticipated with additive white Gaussian noise in which it is not affected by inter-symbol interference (ISI). This serves as a good starting point for comprehending basic performance relationships. Thethermal noise generated in the receiver end is the primary source of performance degradation (Omijeh and Agoye, 2015).

Mathematically, thermal noise is expressed thus:

$z = a + n$ (2) (5)

Where pdf for Gaussian noise can be represented as follows where is the variance of n.
A simple model for thermal noise assumes that its power spectral density Gn(f) is a flat for all frequencies and is denoted as;

$$p(z)=\frac{1}{\;}\exp\left[-\frac{1}{2}\left(\frac{n}{\sigma}\right)^{2}\right] \qquad (6)$$

$$G_n(f)=\frac{N_0}{2}$$

Such that the factor of 2 is being included to show that Gn(f) is a two-sided power spectral density [7].

III. METHODOLOGY

Matlab/Simulink was used to develop a model with which efficiencies of M-ary PAM and M-ary PSK via different modulation techniques (AWGN and Rayleigh) were analyzed (Weizheng, 1997; Omijeh, 2016). Figure 1 Shows the model-based design using Simulink.

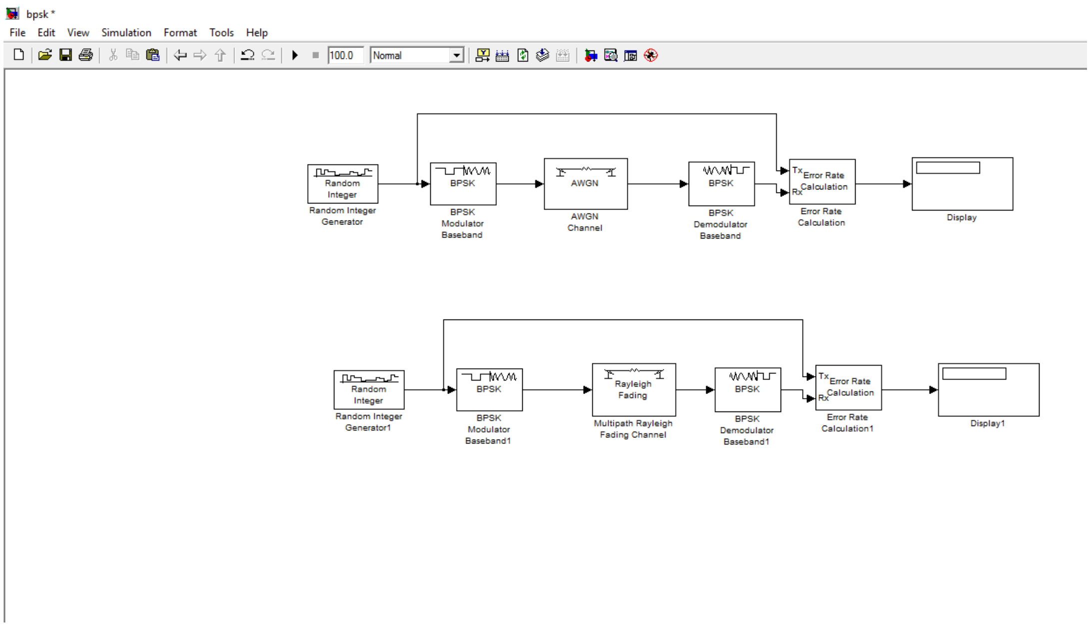

Fig. 1(a) PSK in WCDMA with AWGN and Rayleigh Fading modulation channels

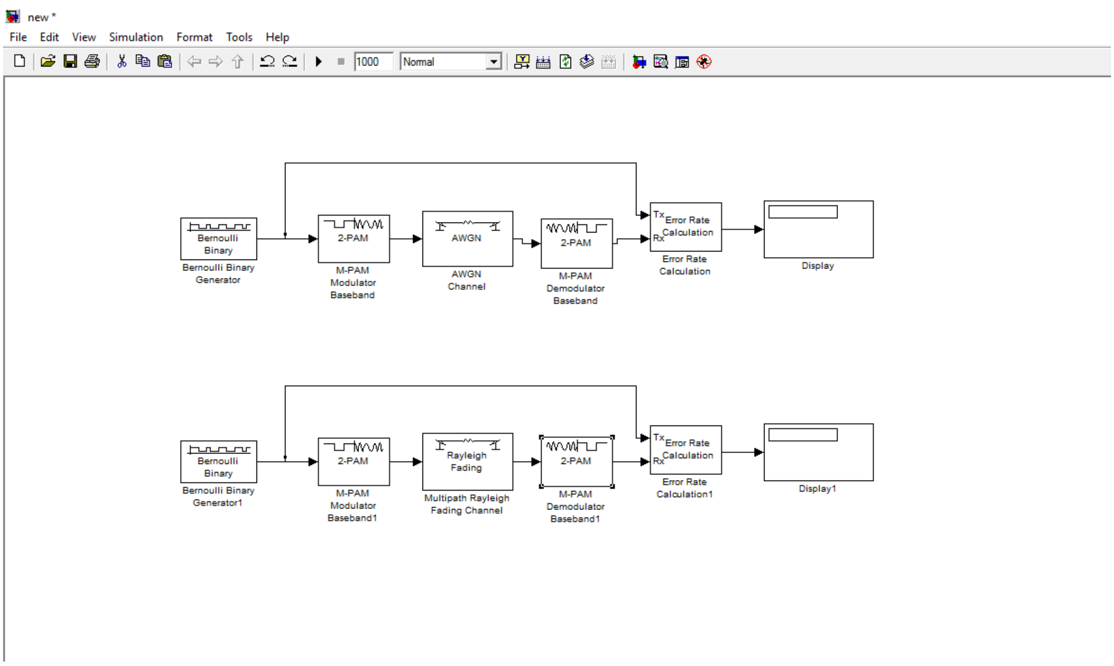

Fig. 1(b) PAM in WCDMA with AWGN and Rayleigh Fading modulation channels

IV. RESULTS AND DISCUSSIONS

The results obtained after simulation are summarized in figures 2-9.

In Fig.2 and Fig.3, for M-PSK and M-PAM through the AWGN channel, we can see that the BER is minimal when the M-file is 2, and the BER is progressive as the M-file is increased.

Also in Fig.2 to Fig.5, as both modulation schemes are analyzed through Rayleigh channel, the BER is also minimal between M-Ary numbers of 2, 4 and 8, and hence progresses as the M-Ary numbers does.

In this paper, in Fig.6 we also have that as the simulation run time is varied at intervals of 100 up till 1000, and M-PSK passes through AWGN channel, the BER is regularly progressive at different M-Ary number. But in Fig.7 the BER is irregular at different M-Ary number when the M-PSK is passed through Rayleigh channel.

Finally, in Fig.8 we see that as the simulation run time is varied at intervals of 100 up till 1000, as M-PAM passes through AWGN channel, the BER is not displayed in this analysis because of our model, whereas in Fig.9 the BER is once again irregular at different M-Ary number when the M-PSK is passed through Rayleigh channel.

Below are graphs showing the results of performance of both modulation schemes through the 2 different channels as simulation run time and M-Ary numbers are varied;

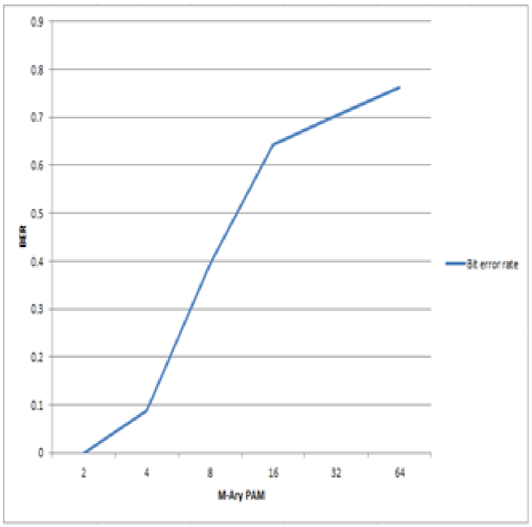

Fig.. 2: BER VS M-Ary PAM via AWGN channel in WCDMA system.

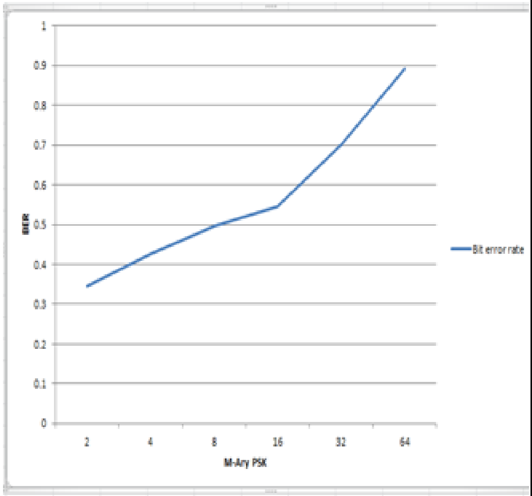

Figure 3: BER VS M-Ary PSK via AWGN channel in WCDMA system.

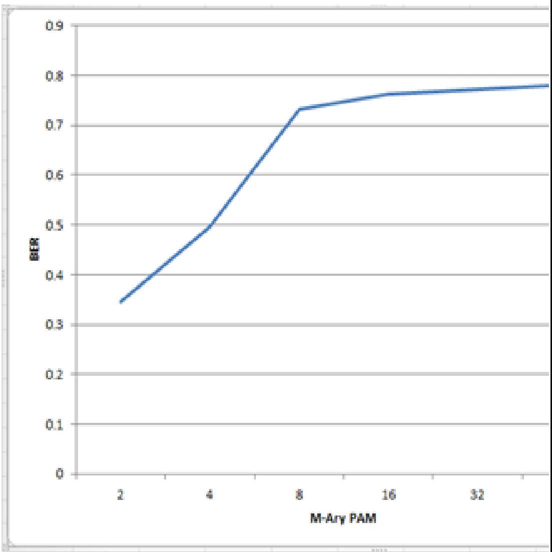

Fig.4: BER VS M-Ary PAM with RAYLEIGH

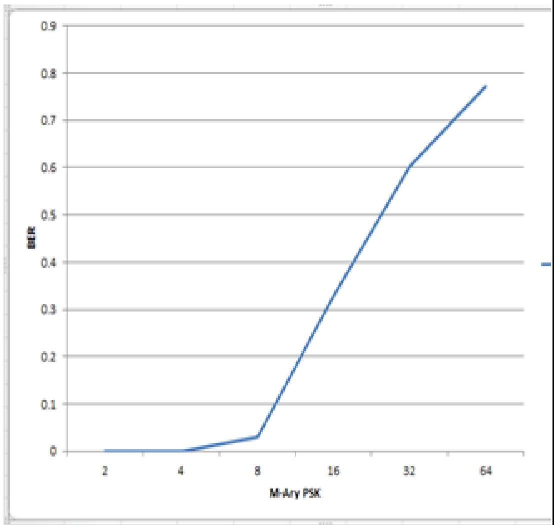

Fig. 5: BER VS M-Ary PSKwith RAYLEIGH Fading channel in WCDMA system.

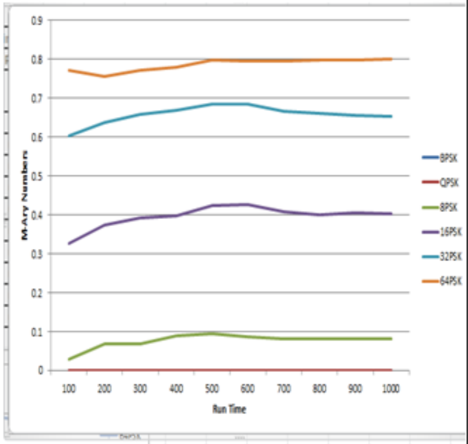

Fig.6:Graphical representation of performance of Run time VS M-Ary numbers in PSK with AWGN channel.

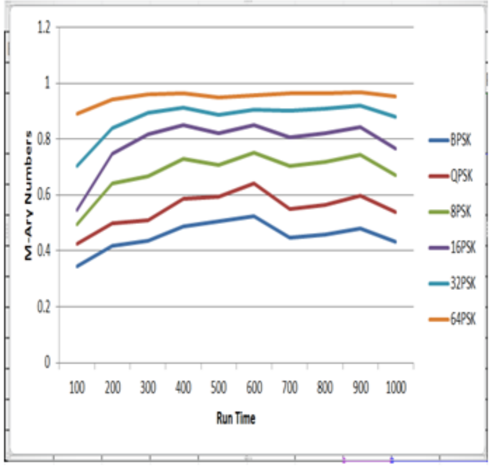

Fig. 7: of Run time VS M-Ary numbers in PSK with RAYLEIGH fading channel.

V. CONCLUSION

The aim of advancement in telecommunication is to transfer information from one end to the other with minimal interference, noise and lose of signal/bits.

In this paper, based on our analysis we can say that it is more efficient to apply the system of M-PAM via the AWGN channel in WCDMA system since the BER is lower compare to the case when M-PSK is passed via AWGN channel considering the variation in M-Ary number.

The system of M-PSK via Rayleigh in WCDMA system is more efficient than that of M-PAM via Rayleigh in WCDMA system because the BER is lower at different M-Ary numbers when compared.

And as the run time increases (or varied), the BER increases i.e. in AWGN channel (for M-PSK), while it is irregular in Rayleigh channel (for both modulation schemes in their various M-Ary numbers).

Since this irregularity occurs in Rayleigh channel, it is seen that at higher run times the BER can be reduced whereas it is not achievable in the case of AWGN. Hence, we are not saying it is the best choice, but depending on the situation, one can decide which system to apply especially to achieve clearer transmission.

REFERENCES

[1]. Ling.F (1995):"Matched filter-bound for time-discrete multipath Rayleigh fading channels,"

[2]. *IEEE Trans. Veh. Technol.*, vol. 43, no. 2/3/4, pp. 710-713, Feb./Mar./Apr. 1995

[3]. Rashmi Suthar, Sunil Joshi, Navneet Agrawal(2016): Performance Analysis of Different M-ARY Modulation Techniques in Cellular Mobile Communication,*IP Multimedia Communications A Special Issue from IJCA - www.ijcaonline.org.accessed 2016*

[4]. Ruchi G,Arora.A.K, Akhilesh k.Y(2016):Comparison of Different Multipath Channel, Based on Bit ErrorRate by Using Higher Order Modulation Techniques For Wcdma, International Journal of Advances in Engineering Science and Technology, www.sestindia.org/volume-ijaest/ and www.ijaestonline.com, pp:73-81,accessesd 2016

[5]. **Omijeh1.B.O, Adabanya .C.E (2015):** Computer-Based Comparative Analysis of BPSK

[6]. versus other PSK Modulation Models,***International Journal of Advanced Research in Computer and Communication Engineering*** *Vol. 4, Issue 10, October 2015* **DOI 10.17148**

[7]. Omijeh .B.O and Ehikhamenle.M (2015): Modelling And Analysis Of A Cdma2000 Physical Layer Using Awgn To Emulate A Wireless Channel, International Journal of Electronics and Communication Engineering & Technology (IJECET) Volume 6, Issue 12, Dec 2015, pp. 49-56

[8]. Omijeh .B.O and Agoye.S.D.O (2015): Comparative Evaluation of Different Digital Modulation Schemes on AWGN, LOS and Non-LOS Fading Channels Based on BER Performance. International Journal of Scientific & Engineering Research, Volume 6, Issue 10, October-2015

[9]. Omijeh.B.O and Udoh.M.I (2015) : Performance Analysis of the WCDMA End-To-End Physical Layer

[10]. International Journal of Engineering and Technology Volume 5 No. 12, December, 2015 pp: 623-635

[11]. *Omijeh.B.O (2016): Applied Engineering Mathematics with Matlab/Simulink,* M & J Grand Orbit Communications Ltd ,Port Harcourt, **2016 ; PP:201-203**

[12]. Saiful Islam, Hasan Rahman, Jakeya Sultana (2015): Performance Analysis of QAM and QPSK in AWGN and Multipath Fading Channel, *International Journal of Advanced Research in Computer Science and Software Engineering 5(5), May- 2015, pp. 1648-1654.*

[13]. Tharakanatha1.G, Mahaboob kamal.S.K, basha, Vijay Bhaskar chanda, I. Hemalatha4 (2013): Implementation and Bit Error Rate analysis of BPSK Modulation and Demodulation Technique using MATLAB, International Journal of Engineering Trends and Technology (IJETT) – Volume 4 Issue 9- Sep 2013.pp:4010-4014

[14]. Vishwas G. G, Sandhya .S (2012): Performance Analysis of Different M-ARY Modulation Techniques over wireless fading channel, *IOSR Journal of Electronics and Communication Engineering (IOSR-JECE),. Volume 4, Issue 1 (Nov. - Dec. 2012), PP 32-38.www.iosrjournals.org*

[15]. Weizheng.W(1997): Simulink Communication Toolbox, Mathworks, Inc. http:www.mathwork.com