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PERFORMANCE ANALYSIS OF A DS-CDMA SYSTEM BY USING RAYLEIGH AND NAKAGAMI-M FADING CHANNEL

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Abstract— *In this paper, we study the expressions for Signal to- Noise plus Multi Access Interference Ratio (SINR) without and with receive diversity considering Nakagami-m fading channel. The analysis is also extended to Rake receiver with Maximal Ratio Combining (MRC) technique with multiple receiving antenna. The results are presented in terms of BER and improvement of receiver sensitivity due to diversity. Finally, optimum values of system parameters like number of orthogonal frequency division multiplexing (OFDM) sub-carrier, optimum code length and order of receive diversity for a given BER are determined. It is noticed that there is significant improvement due to receive diversity, higher order code length as well as OFDM sub-carrier in a Multi-carrier direct sequence code division multiple access (MC-DS-CDMA) system. In Proposed work we will work on the relationship between MRC diversity and Nakagami-m fading is investigated. The error performances of several modulation schemes with diversity over Rayleigh fading and without diversity over Nakagami-m fading is analyzed and compared. The analysis is further extended to diversity over Nakagami-m fading channel. An attempt has been made to find the physical interpretation of Nakagami-m with MRC diversity over Rayleigh fading channel. A novel equivalence is obtained between diversity orders over Rayleigh fading and Nakagami parameter m.*

Keywords— MAI, SINR, OFDM, MRC

I. INTRODUCTION

With the tremendous increment in the users count and introduction of new features including web browsing. In the past few years, the request for bandwidth has started to surpass the availability in wireless networks. Different techniques have been studied to improve the bandwidth, efficiency and increase the number of users that can be accommodated within each cell [2]. The International Telecommunication Union (ITU) likewise characterized recommendations for mobile communication framework for fourth era (4G).In these recommendations, information rates up to 100 Mbps for high portability and up to 1 Gbps for low versatility or nearby wireless are anticipated. Frameworks satisfying these prerequisites are typically considered as 4G frameworks. Be that as it may, third generation (3G) frameworks give information rate of around 3.6-7.2 Mbps. Existing multiple access techniques used in 1G/2G/3G systems (such as FDMA/TDMA/CDMA respectively) are basically suitable for voice communication only and unsuitable for high data rate transmission and burst data traffic which would be the dominant portion of traffic load in 4G system [2]. In present day communication framework Code-Division-Multiple –Access (CDMA) has had its effect in remote correspondence. It offers surely understood components, for example, dynamic channel sharing ,delicate capacity, reuse variable of one, low dropout rate and expansive scope (because of delicate handover),ease of cell arranging, vigor to channel hindrances and insusceptibility against obstruction and so on. These points of interest are accessible because of spreading the data over an extensive transmission capacity. The execution of regular CDMA framework is restricted by numerous get to obstruction (MAI) and in addition Inter image Interference (ISI) [4]. Likewise, the intricacy of CDMA multiuser location has dependably been a genuine worry for extensive no. of clients. DS-CDMA is the most famous method of CDMA procedures. The DS-CDMA transmitter duplicates every client's flag by a particular code waveform. The finder gets a signal composed out of the aggregate of every one of clients' signs which cover in time and frequency [2] [10]. DS-CDMA demonstrates a few favorable advantages which are simple frequency arranging, high resistance against obstruction if a high handling increase is utilized, adaptable information rate adaption and so forth.

II. LITERATURE SURVEY

A. Sudhir Babu and Dr.K.V.Sambasirao in their paper, "Evaluation of BER for AWGN, Rayleigh and Rician presumed that from the reenactment comes about that the BER of computerized correspondence framework is a critical figure of legitimacy used to evaluate the trustworthiness of information transmitted through the framework. By actualizing the distinctive tweak [11] methods, the standard is examination of variety of BER of various for various SNR. It is watched that the BER is least for AWGN and most extreme for Rayleigh and Rician.

Sidratul Moontaha, Farhana Akter, A K M Nazrul Islam, Farhana Rahman composed paper "BER Performance of DS-CDMA System over a Multipath Rayleigh Fading Channel Considering Path Gain Component and Noise Variance". In this paper, we have attempted to diminish the bit blunder rate of an uplink (switch connect) DS-CDMA framework. For this reason, recurrence specific and multipath Rayleigh blurring channel with power control

utilizing standard Gaussian estimate (SGA) has been considered. Here, the way pick up segment has been viewed as Rayleigh appropriation.[7] The final observation of our simulation is that the BER performance of DS-CDMA system is highly influenced by this path gain component and noise variance. This work can be further extended considering path gain component and other parameters in multicarrier direct sequence CDMA (MC-DS-CDMA) and orthogonal frequency division multiplexing (OFDM). Mr. G. A. Bhalerao and Prof.R.G.Zope in their paper," BER Improvement of DS CDMA with rake receiver using Multipath fading channel", had studied the performance of DS CDMA system for various users.
By studying all the above papers, we can have the performance of communication system for various parameters like BER, various fading channels, modulation techniques.

III. METHODOLOGY

A. BPSK Modulation

Modulation is an important step of communication framework. Modulation is characterized as the procedure whereby a few attributes (line plentifulness, frequency, stage) of a high recurrence flag wave is shifted agreement with prompt esteem power of low frequency signal wave which is balancing wave. There are many sorts of modulation, for example, APSK, QPSK, QAM, BPSK. Be that as it may, here we are utilizing BPSK modulation procedure.

BPSK (additionally once in a while called PRK, stage different keying, or 2PSK) is the most straightforward type of stage move keying (PSK). .This modulation is the most strong of all the PSKs since it takes the largest amount of clamor or twisting to make the demodulator achieve an inaccurate choice. It is, nonetheless, just ready to balance at 1 bit/image as is unsatisfactory for high information rate applications. Consider a sinusoidal bearer. In the event that it is modulated by a bi-polar bit stream as indicated by the plan delineated in Figure 1, its polarity will be reversed each time the bit stream changes extremity. This, for a sine wave, is proportional to phase reversal (shift). The multiplier output is a BPSK 1 signal. The data about the bit stream is contained in the progressions of period of the transmitted signal. A synchronous demodulator would be delicate to these stage inversions. A depiction of a BPSK motion in the time space is appeared in Figure 2 (lower follow). The upper follow is the binary message grouping.

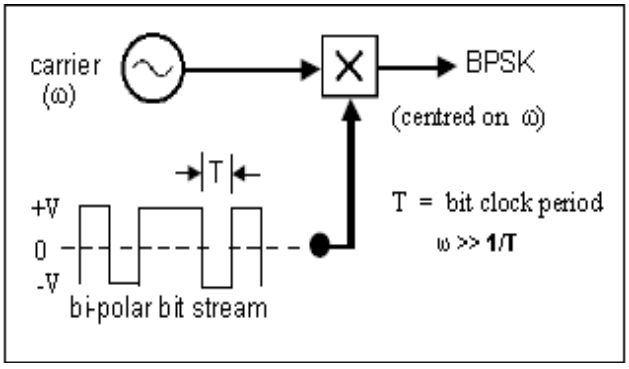


Fig.1 Generating BPSK Signal

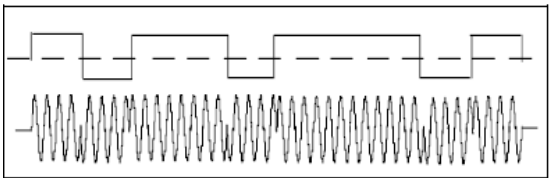


Fig.2 BPSK Signal

The upper follow is the paired message succession. There is something exceptional about the waveform of Figure 4.2. The wave shape is "symmetrical" at each stage move. This is on the grounds that the bit rate is a sub-different of the bearer recurrence 1/(2π). Furthermore, the message moves have been planned to happen at a zero-intersection of the carrier. While this is referred to as 'extraordinary', it is normal by and by. It offers the benefit of streamlining the bit clock recuperation from a got flag. Once the bearer has been procured then the bit clock can be determined by division.

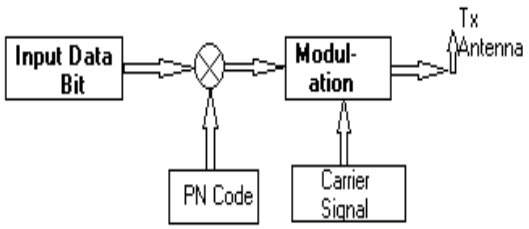
The Nakagami fading model was initially proposed because it matched empirical results for short wave ionospheric propagation. In current wireless communication, the main role of the Nakagami model can be summarized as follows :

1. It describes the amplitude of received signal after maximum ratio diversity combining.
2. The sum of multiple independent and identically distributed (i.i.d.) Rayleigh-fading signals have a Nakagami distributed signal amplitude. This is particularly relevant to model interference from multiple sources.
3. The Nakagami distribution matches some empirical data better than other models

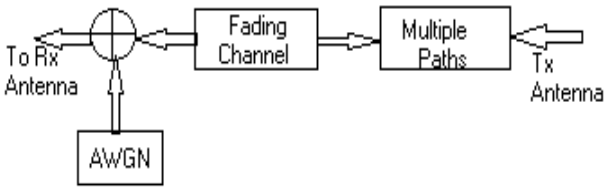
The Rician and the Nakagami model behave approximately equivalently near their mean value. This observation has been used in many recent papers to advocate the Nakagami model as an approximation for situations where a Rician model would be more appropriate.

IV. SYSTEM ARCHITECTURE

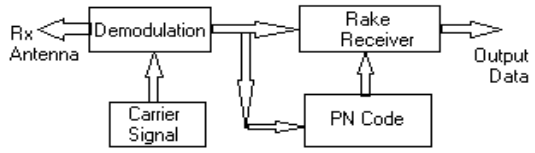
The framework outline for performance examination of DS CDMA with various fading channels is as appeared in figure 3. At the transmitter, the data is encoded utilizing codes. The encoded data is then change into an information modulated symbol arrangement with a base band modulator. The modulated symbol arrangement is spread in time space by a chip sequence of PN code generator, generally Walsh code and PN succession. The data is molded and gone through channel for transmission. At the beneficiary end, the data is increased with chip grouping by the connections in the Rake recipient. The data is then summed and increased by nearby created spreading code, which is de spreading. The data is demodulated and decoded and unique information can be recuperated.



Transmitter



Channel



Receiver

Fig.3 System Architecture

V. EXPERIMENTAL RESULTS

a. Simulating BER vs SNR in MATLAB

For the analysis of the proposed system following steps will be carried out:

1. Random BPSK signals will be generated and passed through the AWGN channel, Nakagami channel, and Rayleigh channel.
2. Received signal is demodulated.
3. Numbers of errors will be counted.
4. For Nakagami channel by varying M factor number of BER values can be obtained.
5. Result will be plotted.

VI. OBSERVATIONS WITH RESULTS

Following table no.1 shows the BER values for different SNR values without Rake receiver using BPSK modulation and PN code for AWGN and Nakagami-m fading channel. AWGN channel is good in terms of BER as compared to Nakagami-m fading channel.

Table No. 1 BER values for fading channels

Sr.No	SNR Values (dB)	BER Rayleigh channel	BER AWGN Channel
1	1	0.4000	0.2666
2	2	0.4500	0.2476
3	3	0.4700	0.2225
4	4	0.5200	0.2050
5	5	0.5300	0.1714
6	6	0.5400	0.1428
7	7	0.5500	0.1161
8	8	0.4800	0.0882
9	9	0.5000	0.0652
10	10	0.5100	0.0464

Below figures shows the output of the DS CDMA System by using Rayleigh fading, Nakagami-m fading, AWGN fading Channel. It shows that the BER is less for AWGN Channel as compared to the Rayleigh and Nakagami channel. The performance under Rayleigh fading channel is very uneven.

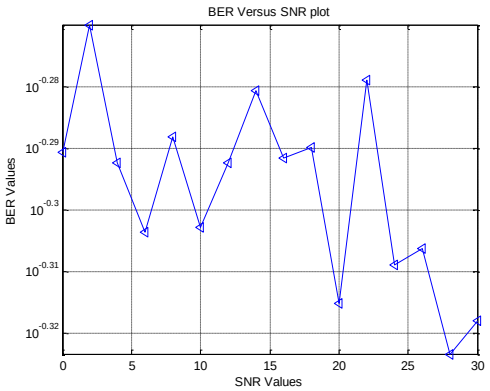


Fig.4 Using Rayleigh fading channel

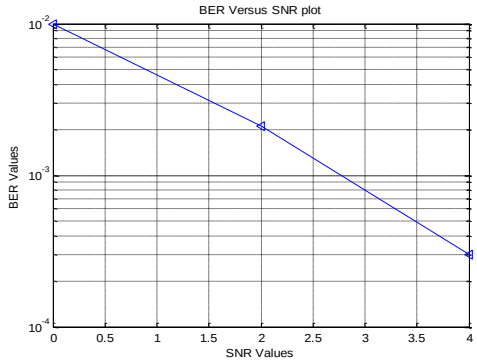


Fig.5 Using Nakagami-m Fading channel (m=1)

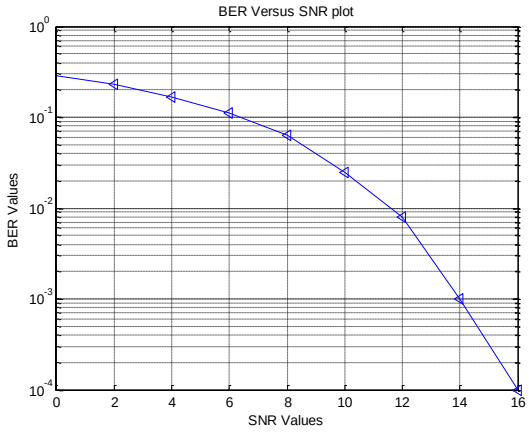


Fig.6 Using AWGN Channel

Following table no.2 shows the BER values for different SNR values without Rake receiver using BPSK modulation and PN code for different values of m- factor using Nakagami-m fading channel. AWGN channel is good in terms of BER as compared to Nakagami-m fading channel. It is observed that for higher values of m BER values are less. For negative values of m it shows spikes which are not good for efficient communication system.

Table No. 2 BER values for Nakagami-m fading channels

SNR Values (dB)	BER Nakagami channel (m=1)	BER Nakagami channel (m=2)	BER Nakagami channel (m=0)	BER Nakagami channel (m=0.5)
1	0.0210	0.0738	0.0784	0.0905
2	0.0138	0.0503	0.0573	0.0715
3	0.0078	0.0287	0.0411	0.0456
4	0.0031	0.0171	0.0263	0.0298
5	0.0015	0.0082	0.0120	0.0173
6	0.0004	0.0030	0.0056	0.0079
7	0.0000	0.0005	0.0020	0.0035
8	0.0001	0.0004	0.0009	0.0012
9	0.0000	0.0000	0.0001	0.0005
10	0.0000	0.0000	0.0001	0

VII. CONCLUSIONS

The performance of the framework will be compared at by utilizing the parameters like BER and SNR. We can improve the performance of wireless communication system with parameters BER, SNIR for various fading channels and different modulation techniques. For better productive framework the BER ought to as little as would be prudent. The rake receiver is utilized to diminish the BER because of multipath impedance over channels utilized. The framework demonstrates that how Nakagami-m channel is good as compared to both Rayleigh and AWGN channel. The execution of framework is better for AWGN channel when contrasted with Rayleigh channel. Diverse estimations of BER will be watched for Nakagami channel by shifting m-factor.

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