Novel Approach to reduce BER in Cognitive Radio

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Abstract
In this research paper a technique is introduced to improve Bit Error Rate in cognitive radio. In this paper the FHSS of 32-bit and DSSS of 16-bit is implemented in the network. After implementation of proposed technique results are produced which shown that the proposed approach is far better than that of existing work to reduce BER in a network. Network consists of both wired and wireless topologies.
Keywords
BER, Cognitive Radio, FHSS, DSSS

1. Introduction

Cognitive radio network is a complex multiuser wireless communication system capable of emergent behavior [2]. Cognitive radio wireless network is considered as an advanced technology integration environment with focus on building adaptive, spectrum-efficient systems with emerging programmable radio. The idea of cognitive radio extends the concepts of a hardware radio and a software defined radio from a simple, single function device to a radio that senses and reacts to its operating environment. The main feature of cognitive radio is their ability to recognize their communication environment and independently adapt the parameters of their communication scheme to maximize the quality of service for the secondary users [3].

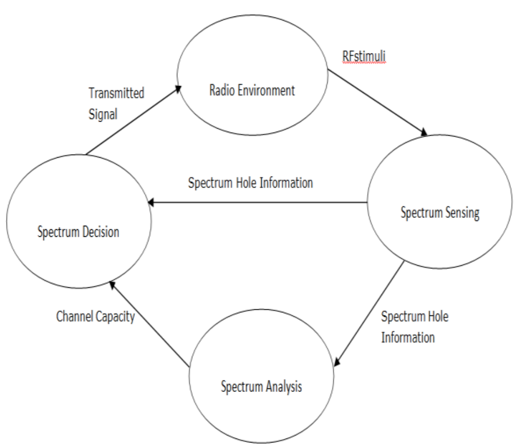

Figure 1: Cognitive Radio Cycle

In cognitive radio cycle a cognitive radio monitors spectrum bands, captures their information and then detects the spectrum spaces. The characteristics of the spectrum spaces that are detected through spectrum sensing are estimated. Then, the appropriate spectrum band is chosen according to the characteristics and user requirements. Once the operating spectrum band is determined, the communication can be performed over this spectrum band.

Cognitive Radio Functions & Primary Objectives

Cognitive radio embodies the following functions:
a) It perceives the radio environment by empowering each user's receiver to sense the environment on a continuous time
basis.
b) It learns from the environment and adapts the performance of each transceiver to statistical variations in the incoming RF stimuli.
c) Facilitates communication between multiple users through cooperating in a self-organized manner.
d) To control the communication process among competing users through the proper allocation of available resources.
e) To create the experience of intention and self-awareness.

Primary objectives of cognitive radio networks:
I. Facilitate efficient utilization of the radio spectrum in a fair-minded way.
II. To provide highly reliable communication for all users of the network.

Bit Error Rate: The Error Rate Calculation compares input data from a transmitter with input data from a receiver. It calculates the error rate as a running statistic, by dividing the total number of unequal pairs of data elements by the total number of input data elements from one source. We can compute either symbol or bit error rate, because it does not consider the magnitude of the difference between input data elements. If the inputs are bits, then the block computes the bit error rate. If the inputs are symbols, then it computes the symbol error rate. The bit-error rate is the main performance parameter of a digital communication system
[1]. The growing complexity of optical links has increased the impact of nonlinear effects calling for efficient numerical algorithms for BER estimation. One way to lower the spectral noise density is to reduce the bandwidth,

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but we are limited by the bandwidth required to transmit the desired bit rate (Nyquist criteria).We can also increase the energy per bit by using higher power transmission, but interference with other systems can limit that option
[2]. A lower bit rate increases the energy per bit, but we lose capacity. Ultimately, optimizing Eb/No is a balancing act among these factors. The bit error rate is one of the most important quality criteria for digital transmission systems. As many systems are too complex for an analytical derivation, Monte Carlo simulation is often applied for bit error rate estimation. If the transmission system employs a Log APP decoder.
[3]. which outputs the aposteriori log-likelihood ratio (LLR) of each bit, there are two different methods available. Here in the block diagram given below the message comes from information source which can be measured in bits .Message comes from source information is electrical in nature it will be unsuitable for immediate transmission .On source side there is a transmitter that is a device that makes electrical information suitable for efficient transmission over a given channel .Transmitter modulate or change some parameters like amplitude and frequency .Channel is used to refer the frequency range allocated to particular sequence. Noise may interfere the signal at any point in communication system which will affect when signal is weak [4]. Noise means unwanted energy. Important function of receiver is to demodulate and output of receiver is fed to loudspeaker.

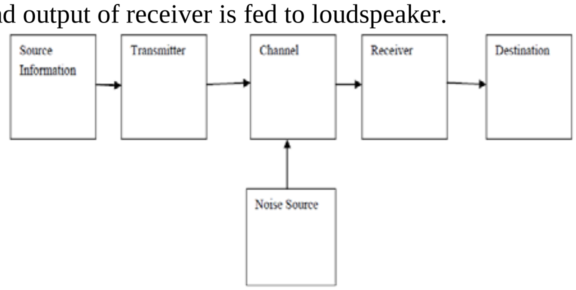

Figure2. Block diagram of Communication System

2. Analysis of BER

The BER may be analyzed using stochastic computer simulations [5].It can be demonstrated with two different definitions.
Binary symmetric channel (used in analysis of decoding error probability in case of non-burst bit errors on the transmission channel)
Additive white Gaussian noise (AWGN) channel without fading.
A worst case scenario is a completely random channel, where noise totally dominates over the useful signal [6]. This results in a transmission BER of 50% In a noisy channel, the BER is often expressed as a function of the normalized carrier-to-noise ratio measure denoted by Eb/N0 (energy per bit to noise power spectral density ratio), or Es/N0 (energy per modulation symbol to noise spectral density).Bit error rate may be expressed in mathematical terms as shown below.

$$BER_i = 1/2 \text{erfc} [\sqrt{E_{b,i}/N_0}] \quad (1)$$

Table1.Different kinds of modulations and their order.

S.NO	MODULATION	MODULATION ORDER	OTHER CHOICE
1	PSK	2	Diversity order>=1
2	QPSK	4,8,16,32,64 OR high power of 2	Diversity order>=1
3	DPSK	4	Diversity order>=1
4	PAM	2,4,8,16,32,64 or high power of 2	
5	QAM	4,8,16,32,64,128,256,512,1064 or high power of 2	Diversity order>=1
6	FSK	2	Diversity order>=1

People usually plot the BER curves to describe the functionality of a digital communication system. In optical communication, BER (dB) vs. Received Power (dbm) is usually used; while in wireless communication, BER (dB) vs. SNR (dB) is used [7]. Measuring the bit error ratio helps people choose the appropriate forward error correction codes. A more general way of measuring the number of bit errors is the Levenshtein distance.

3. Literature Survey

Literature survey shows that work has been done proposed to study the ber of the modulation scheme to achieve higher data speed and less probability of error for robust and reliable communication with many techniques employed for various modulation schemes under different environments with varied channel coding. The paper [2] presents the matlab based study on the two kinds of modulation demodulations under the different noises. And focuses on the research for ber of bpsk coherent demodulation along with bdpsk coherent demodulation and bdpsk incoherent demodulation. In paper [3] aim is to analyze and compare the performance of cofdm in awgn, rayleigh, rician & nakagami fading environments. The channel coding used is reed solomon (rs) code with ½ and 2/3 convolution codes. The paper [4] presents the performance of different iterative decoding algorithms for turbo codes in new wireless systems is evaluated in realistic radio conditions, i.e., considering the transmission of an ofdm signal over a fading channel .in paper[5] the research is investigated in several aspects to evaluate the performance of turbo codes in rician fading channel with low rician k-factor, such as using different channel model, different coding rate, different internal inter leavers, and different rician factors. The simulation results give some demonstrations that are valuable for the application of turbo codes in rician fading channel with low rician k-factor. In[6] this paper aim is to analyze and compare the performance of cofdm using turbo codes {with log-map (maximum a posteriori) decoding} and reed solomon (rs) code with 1/2 and2/3 convolution codes (cc) as channel coding techniques in rayleigh, rician & nakagami fading environments. The performance parameter is ber and the mapping schemes used are bpsk, qpsk, 16-qam and 64-qam. In [7] this paper we address the problem of channel equalization and phase noise suppression in orthogonal frequency division multiplexing (ofdm) systems. For ofdm systems, random phase noise introduced by the local oscillator causes two effects: the common phase error (cpe), and the inter carrier interference (ici). The proposed approach uses a pilot tone aided particle filter to track/estimate the effective dynamic channel in the time domain and equalizes in the frequency domain.

4. Techniques for Finding BER

SEMI -ANALYTIC METHOD

simulations can improve their speed with a slight degradation in accuracy by using the semi-analytic method. In contrast to the dimensioning process, cell-planning tools perform the calculation based on the Knowledge of the site locations and the intensity of traffic in a given scenario [8]. Hence a slightly more complicated process has to be adopted in order to apply the semi-analytic method in cell-planning tools. Briefly, the statistics of power requirements in each pixel inside the coverage of each sector has to be calculated first, then based on the offered traffic the blocking probability could be calculated [9]. The capacity N is calculated based on the power requirement distribution for a given inter-site distance. By noting that the interference ratio is independent of the inter-site distance, it is possible to incorporate the change in performance due to different inter-site distances by including the effect of thermal noise. Instead of repeating the interference ratio calculation for another inter-site distance, it is possible to correct the interference ratio by Including the thermal noise floor in the calculation [10]. At the end a capacity-coverage trade-off curve can be created.

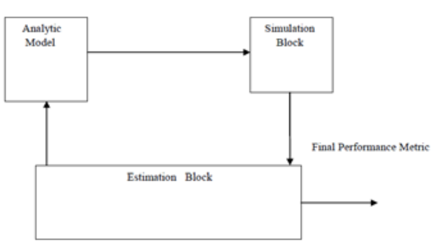

Figure2. Semi Analytic Approach

MONTE CARLO METHOD

Monte Carlo BER estimation an be defined with the help of two different BER samples [11].For determining bit error rate of Transmission system, We have two kinds of BER samples are considered

(a) Hard BER sample: For given signal, ZH = 0 if u = û. = 1 if u ≠ û. Where soft output is then reseperented into its sign û = sign (L) and its magnitude λ= abs (L)

(b) Soft BER Samples: For given signal, ZS = [1÷1+eλ] where λ is the magnitude and this magnitude represent the reliability.

5. Proposed Work

In this paper a technique to improve the Bit Error Rate is introduced. In this technique the bandwidth and channel modulation is updated. By updation in both the techniques packets quality is improved because packets are transmitted on a channel which has more bandwidth and modulation scheme.

Results & Discussion

In this proposal a network is developed in which a primary user and secondary user is created. Secondary user take access from primary user by checking out the frequency of the primary user. Following is the screen shot of network topology.

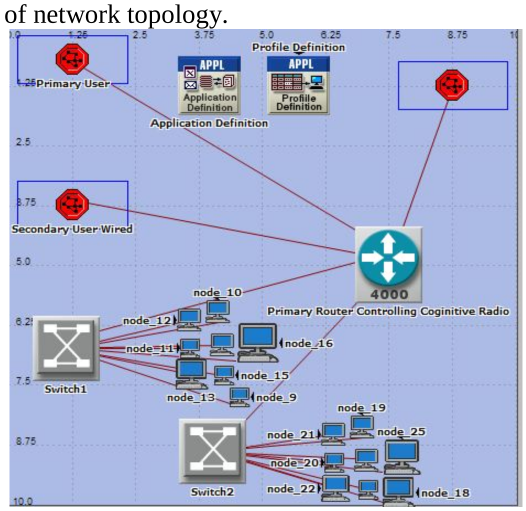

Figure 3. Network Topology for BER

The above defined network topology used QPSK modulation scheme.

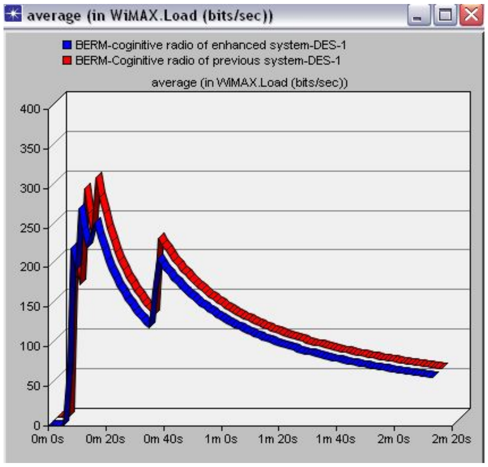

Figure 4. Load depicted in wimax

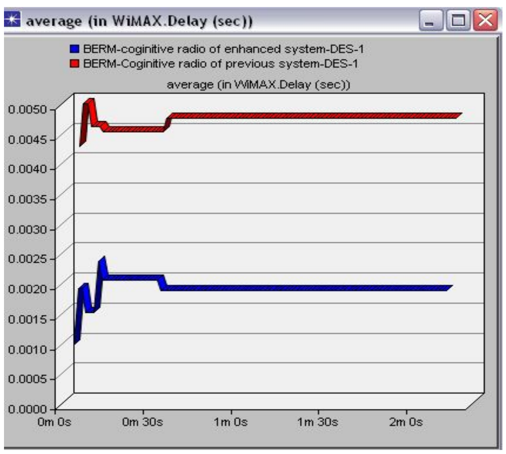

Figure 5 Delay in wimax

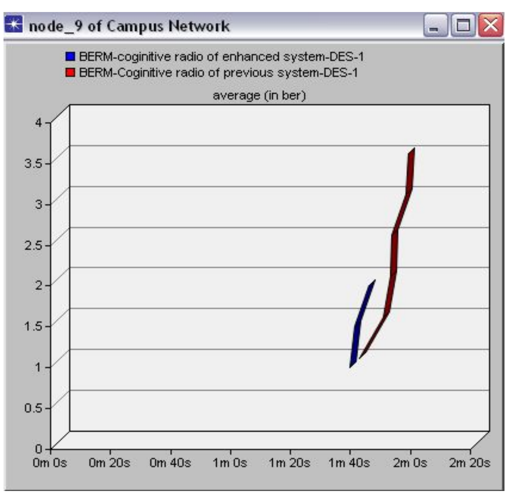

Figure 6. BER

Conlusion

In this paper, a technique is introduced to reduce the Bit Error Rate in Cognitive radio which also include FHSS and DSSS. In this primary user and secondary user are used and in this research and modified technique is used which produced the results that are given above. As given in the results above it is clear that the modified approach is far better than that of existing approach. It improved BER as well as QOS parameters in network.

References

[1] H. J. Richter, A. Y. Dobin, O. Heinonen, K. Z. Gao, R. Veerdonk, R. T. Lynch, J. Xue, D. Weller, P. Asselin, M. F. Erden, and R. M. Brockie, "Recording on bit-patterned media at densities of 1 Tb/in² and beyond, " IEEE Transactions on Magnetics, vol. 42, pp. 2255-60, 2006.

[2] J. Fidler, T. Schrefl, D. Suess, O. Ertl, M. Kirschner, and G. Hrkac, "Full micromagnetics of recording on patterned media," Physica B, vol. 372, pp. 312-15, 2006.

[3] M. E. Schabes, " Micromagnetic simulations for terabit/in2 head/ media systems, " Journal of Magnetism and Magnetic Materials, vol. 320, pp. 2880-2884, 2008.

[4] B. Livshitz, A. Inomata, H. N. Bertram, and V. Lomakin, "Analysis of recording in bit patterned media (BPM) with parameter distributions," Journal of Applied Physics, vol. 105, pp. 07C111, 2009.

[5] P. Hoeher, I. Land, and U. Sorger, “Loglikelihood values and Monte Carlo simulation some fundamental results,” in Proc. Int. Symp. on Turbo Codes & Rel. Topics, Brest, France, Sept. 2000, pp. 43–46.

[6] I. Land , P . Hoeher, and U. Sorger, “On the interpretation of the APP algorithm as an LLR filter,” in Proc. IEEE Int. Symp. Inform. Theory (ISIT), Sorrento, Italy, June 2000, p. 415.

[7] D. van den Borne, S. L. Jansen, G. D. Khoe, H. de Waardt, “Line Optimization in Long-Haul Transmission Systems with 42.8-Gbit/s RZDQPSK Modulation,” in Proc. OFC ’06, Anaheim, CA, paper OFD2, 5- 10 Mar. 2006.

[8] O. V. Sinkin, R. Holzlohner, J. Zweck and C.R. Menyuk,“Optimization of Split-Step Fourier Method Modeling Optical-Fiber Communications Systems,” J. Lightw. Technol., vol. 21, no. 1, pp. 61-68, Jan. 2003.

[9] A. H. Gnauck and P. J. Winzer, “Optical Phase-Shift-Keyed Transmission,” J . Lightw. Technol., vol. 23, no. 1 , pp.115-130, Jan. 2005

[10] Yu Tang, Xiao-lan Lv “Research on the modulation and demodulation of BPSK and BDPSK simulator based on Matlab”Pg no -1239 - 1241 ,IEEE transactions ,2011.Figure 5. Delay interpreted by network after reducing BER