International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 3 Issue 5, May - 2014

# Adaptive Modulation for Energy Efficiency in Wireless Communication

Yashaswini C. S. [1]
[1] PG Student Dept of EC,CIT
Gubbi, India

Dr. Sureshkumar D S [2]
[2] HOD, Dept of EC,CIT
Gubbi, India

Sanjeev kubakaddi [3]
[3] CEO ITIE Knowledge Solutions
Bangalore, India

Rathnakar Achary [4]
[4] Alliance businesacademy
Bangalore, India

***Abstract:*** **Wireless network become an essential requirement in today's industrial and domestic communication systems. Energy efficiency will become an important design consideration due to the limited battery life of wireless devices. It has to balance with the throughputof the wireless network to attain the quality of service (QOS) demands and availability.Comparing to the growth in semiconductor technologies, there is no considerable progress in battery technologies. It is equally important that, in addition to performance measures such as throughput, bandwidth and fairness, energy efficiency has become one of the important factor to be considered in wireless networking. All aspects of system design, from silicon to applications have affected by the power consumption. The different energy efficient transmission techniques across time, frequency and spatial domains are introduced to develop an energy efficient wireless communication system. In this paper we considered adaptive modulation scheme to optimize the energy consumption per bit of data transfer. This improves the performance of wireless communication system by minimizing the number of retransmission in fading environments.**

***Key words: Energy efficiency, Link-Adaptation, Cross layer, Wireless communication***

## I. INTRODUCTION

Successin energy efficiency without compromising the performance parameters such as throughput, delay and jitter is the primary objective of the proposed system. Wireless communications is looking at many challengesfor delivering real-time applications, due to the requirement of higher data rate [1].This requires energy that depends on battery backup, which may not be rechargeable and renewable. The battery technology improvement is much slower. This have increased the gap between battery capacity and the demand for energy[2].As technology advances people start to have more expectations about future wireless networks. So reducing the energy consumption is the most important design consideration for the wireless systems. The designing of different layers of OSI (Open System Interconnection) model optimizes the system performance, while satisfying given resource constraints. Each layer of the OSI model performs different functions. The link layer and hardware layer are referred as the physical layer. These two layers are the major sources of power sink. The physical layer handles all aspects of the physical communication of the bit stream, data encoding, modulation/ demodulation, and physical transmission/ reception. Data link layer is responsible for data flow over a network. It handles channel access for delivering the data packets over the network as well as converts and buffers packets into data frames. Frame level error prevention, detection and correction are handled at this layer. Both physical and medium access control (MAC) layer can be considered in cross layer energy minimization frame work [1].For maintaining user's QOS requirement, the MAC layer ensures that wireless resources are efficiently allocated to maximize network wide performance. At the MAC layer, the standby power is reduced by power management. This is achieved by developing co-ordination between the devices. These devices can wake up exactly when they are ready to transmit or receive data [3, 4].



### *1.1 Related Works*

More work has been carried out by researchers in the last decade for energy efficient, high quality and low cost wireless access services. The solution can be divided into two classes, they are customer oriented and infrastructure oriented solutions. Wireless sensor nodes [3] and mobile terminals are the customer devices those are powered by batteries. Improving the energy efficiency for longer battery backup is the main objective of customer oriented solutions. The hardware design[4], software applications, and protocol enhancement are the various methods that are included in order to achieve prolonged battery life. The total energy consumption compared with customer devices, the network infrastructure contributes to the dominant portion. So to improve the energy efficiency of the overall system the energy consumption of the infrastructure network and the devices should be reduced.Proper network planning, energy modeling, resource allocation are categorized as the research issues by the researchers related with sustainable wireless networks.To enhance the energy efficiency by designing an accurate analytic energy model to prolong the battery life is one of effective method in the energy modeling.One of the most crucial methods to enhance the resource utilization of wireless network is resource allocation [1][4]. Adaptive sleep control of mobile devices, traffic scheduling, routing [3], energy efficient communication and cooperation are the various aspects involved in the resource allocation.The energy in these works such as network planning,energy modeling and resource allocation are generally targeting at maximizing the energy efficiency.The main requirement of the proposed system is to save energy means in order to reduce the energy consumption to make the system, energy efficient.

In this proposed system,adaptive modulation for energy efficient system, we are calculating the Bit error rate (BER) from the different modulation techniques such as QAM, DBPSK, and QPSK. These modulation techniques are involved to calculate BER and Signal to Noise Ratio(SNR)[5]. For energy efficient system, the system should have minimum BER and high SNR (Signal to noise ratio). The SNR and BER, these are the two factors that can influence the quality of the wireless communication system [6]. Due to the time varying characteristics of the wireless link, its quality is affected by many different factors, those are technology dependent and some are determined by environment.We expect that the proposed system adapt the specific modulation technique to result in minimum BER, maximum SNR and also minimum energy consumption per bit.We organized this paper as follows: In section 2 we explained the system architecture, in section 3 the analysis of the energy efficient wireless systems, section 4 the implementation and simulation results followed with conclusion in section 5.

## II. SYSTEM ARCHITECTURE

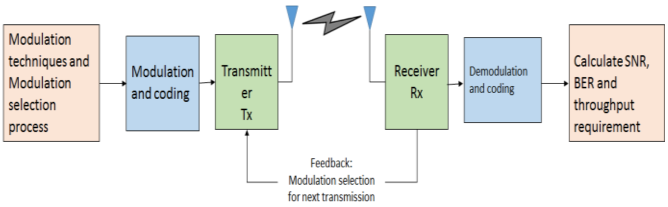


**Figure 1:** Proposed system

Initially in our proposed system, we set the initial parameter that is signal length, later we modulated the considered signal using a specific modulation technique and then transmitted. As we are using simulations to arrive at the BER of the modulation techniques, we are adding some noise to the input message and treating it as received signal. At the receiving end the BER and signal to noise ratio (SNR) is calculated after demodulation. The different modulation techniques such as DBPSK, QPSK and QAM[6] are used. All these modulation techniques are simulated to test the BER and SNR. From this a specific modulation technique is chosen, which result minimum BER and maximum SNR.

## III. ANALYSIS

The DBPSK, QPSK and QAM are the different modulation techniques for reducing energy consumption of the proposed system based on the BER and SNR [1]. Here we discuss different modulation schemes for the estimation of BER and corresponding SNR.The optimal choice of transmission power depends on link distance between two nodes and channel characteristics. Mainly we consider three different modulation techniques such as DBPSK, QPSK and QAM in the proposed system[5, 6].

Consider an input signal with length of *n*-bits. Then apply different modulation techniques to this input signal. As we are using simulation for testing the modulation techniques, add some amount of noise to this signal and transmit the same. Then demodulate the received signal and compare with the input signal. The difference between the input and the demodulation output gives the BER (bit error rate) for particular signal.

Plot the graph between BER and SNR. From the result it is found that, the SNR and BER are inversely proportional to each other. Compare the BERs for the 3 different modulation techniques. The modulation technique with least BER selection for the transmission of data bits. Figure 2 shows the algorithm used for the proposed system.For the simulation purpose, we are fixing the Eb/No range in dB and compute the BER for the vector of Eb/No values to get the exact BER value for different modulation techniques mentioned above. Based on BER values, suitable modulation technique is selected.

## IV.IMPLEMENTATION AND SIMULATIONS

The proposed system is simulated using Mat lab. BER vs. SNR plots for different modulation techniques are shown in figure 3, 4, 5, 6, 7 and 8. From the graph it is found that as the SNR increases BER decreases. For an energy efficient communication results minimum BER. Also for all the experiments conducted for these modulation techniques this observation remains same.Over a range of Eb/No values BER performance in an AWGN channel shows the high SNR and low BER.From the plots for different modulation technique we can conclude that the BERs for different modulation techniques are different.

For an accurate decision process a fuzzy controller is designed by considering the BER and SNR parameter values obtained from the simulation results. Set of rules are defined based on the need and the surface viewer plot is recorded. The fuzzy controller designed is shown in figure 9(a), rule editor for BER vs SNR analysis is shown in figure 9(b) and rule viewer is shown in figure 9(c)

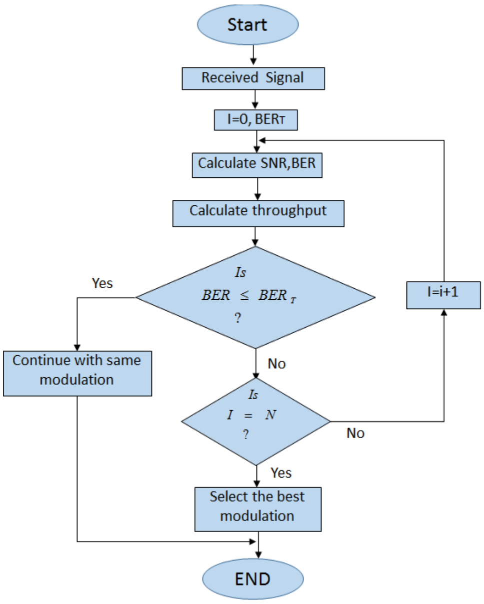


Figure 2: Flow chart for proposed system

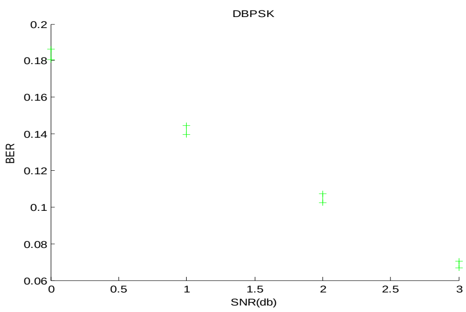


Figure 3: DBPSK Modulation

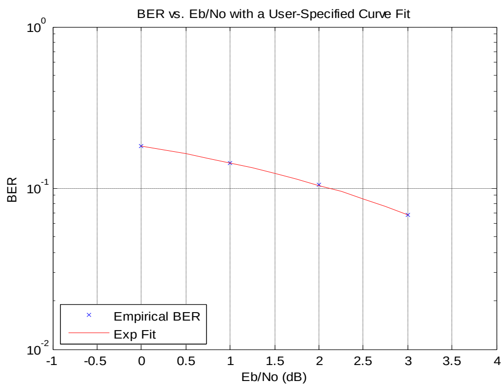


Figure 4: User-specified curve fit for DBPSK

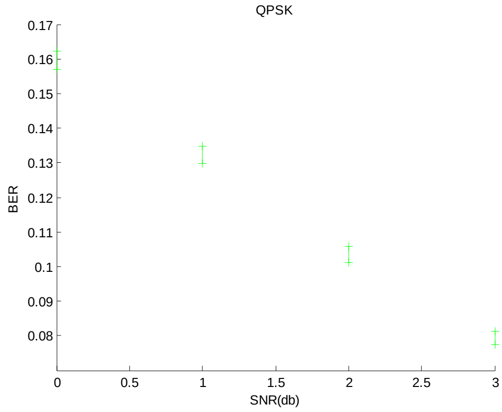


Figure 5: QPSK Modulation

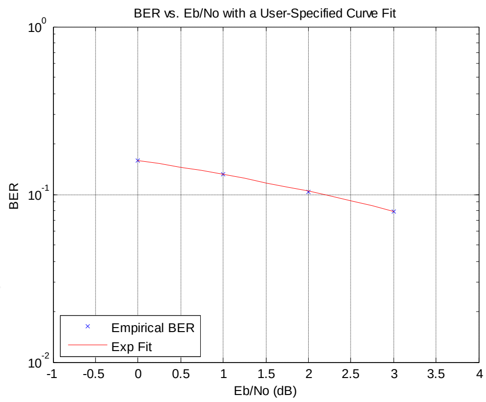


Figure 6:User-specified curve fit for QPSK



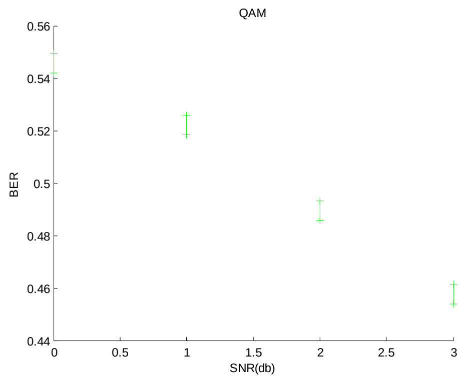


Figure 7: QAM modulation

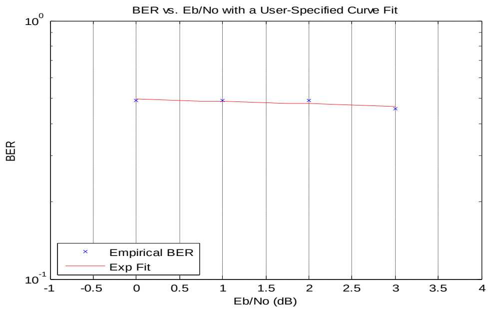


Figure 8: User-specified curve fit for QAM

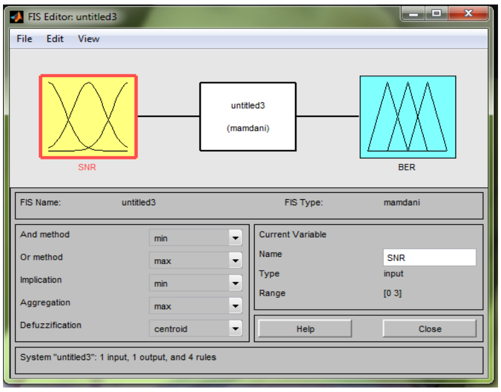


Figure 9(a): FIS editor for BER Vs SNR analysis

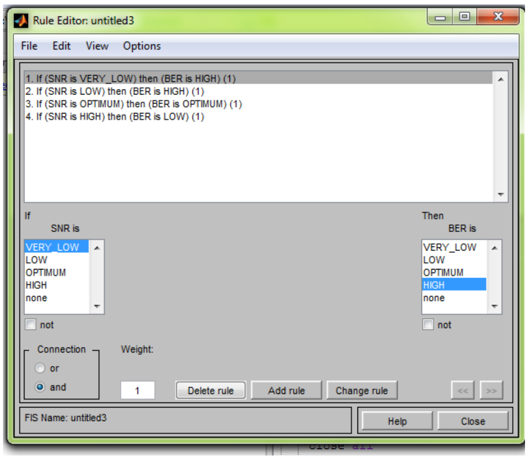


Figure 9(b): Rule editor for BER Vs SNR analysis

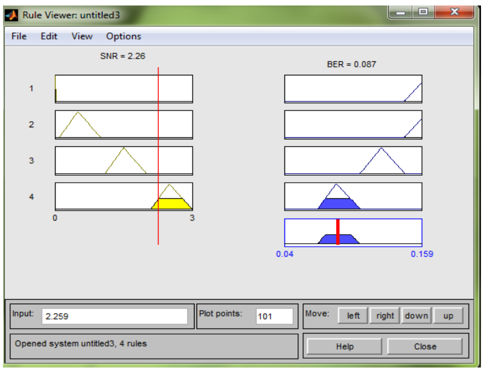


Figure 9(c): Rule viewer for BER Vs SNR analysis

## V. CONCLUSION

The simulation result shows that using the proposed mechanism adaptively selects a specific modulation technique, to result minimum BER and maximum SNR. This reduces the number retransmissions of the data frames, during channel impairment. The increased SNR yields better result in energy efficiency. A high accuracy estimation of BER for different modulation technique is achieved by using fuzzy controller.

## ACKNOWLEDGEMENT

The author would like to thank Dr. Suresh Kumar D S, HOD of Electronics and communication Department ,CIT Gubbi, Mr. Sanjeev Kubakaddi, CEO,ITIE Knowledge solutions, Bangalore and Professor Rathnakar Achary of Alliance Business Academy, Bangalore for their constant motivation, encouragement and guidance to carry out this work.

## REFERENCES

[1]. GuowangMiao ,NageenHimayat , Ye (Geoffrey) Li and Ananthram Swami “Cross-layer optimization for energy-efficient wireless communications: a survey” *Wirel. Commun. Mob. Comput.* 2009; **9**:529–542

[2]. Geoffrey Ye Li, Zhikun Xu, Cong Xiong, Chenyang Yang, Shunqing Zhang, Yan Chen, and Shugong Xu “Energy-Efficient Wireless Communications: Tutorial, Survey” Huawei Technologies Co., Ltd. and the NSF under Grant No. 1017192.

[3]. Daquan Feng, Chenzi Jiang, Gubong Lim, Leonard J. Cimini, Jr., “A Survey of Energy-Efficient WirelessCommunications” IEEE COMMUNICATIONS SURVEYS & TUTORIALS, VOL. 15, NO. 1, FIRST QUARTER 2013.

[4]. Jeffrey Mehlman “Cross-Layer Design for Wireless Sensor Networks: Within the Context of the Optimization Agent Framework”, EE359 Project Proposal 23-October-2009.

[5]. Naomi Ramos, ,DebashisPanigrahiSujit, “Energy-Efficient Link Adaptations in IEEE 802.11bWireless LAN”supported by Center for Wireless Communications (CWC), University of California at San Diego.

[6]. Vineet Sharma, AnurajShrivastav, Anjana Jain, AlokPanday “BER performance of OFDM-BPSK,-QPSK,- QAM over AWGN channel using forward Error correcting code” IJERA Vol. 2, Issue 3, May-Jun 2012, pp.1619-1624.

[7]. Suman Banerjee, ArchanMisra “Adapting Transmission Power for Optimal EnergyReliable Multi-hop Wireless Communication” Watson Research Center, Hawthorne, NY 10532, USA

[8]. http://www.mathworks.in/products/matlab

[9]. Rathnakar Achary, V. Vaityanathan, Pethur Raj, Nagarajan S. “A New QoS Architecture for Performance Enhancement of IEEE 802.11eEDCA by Contention Window Adaption”, ACM Digital Library, ProceedingCICN '12, 2012, pp 74-78