International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 4 Issue 01,January-2015

Optimized Energy Efficient Routing Protocol (OEER) in Mobile Adhoc Network

Anil G. N
Associate Prof: Dept of CSE.
BMS Institute of Technology
Bangalore, India

Dr. A. Venugopal Reddy
Professor
University College of Engineering,
Osmania University
Hyderabad, India

***Abstract*—A mobile Ad-hoc network is a collaboration of portable nodes as well as some computing devices which can be placed arbitrarily anywhere in the network to perform a particular task such as data transmission and message passing etc. The nodes can transmit data in a particular range and the nodes are capable of changing their location. In this infrastructure-less network the node can be deployed in any place of any challenging situation. Since many years the research based on the concept of energy efficiency for routing techniques in the area of mobile AD-hoc network has been considered as an important and challenging field. Mobile Ad-hoc network does not require any centralized support the mobile nodes and the host of the network can be any computing devices with limited power capacity these nodes transmit the data over a short range radio waves. This paper proposes a protocol named "Optimized Energy Efficient Routing Protocol (OEER)" for the optimization of the energy and delay operation within a network path. This paper describes the efficient use of bandwidth of a channel which can be achieved by cooperative Multiple Input Multiple Output technique (MIMO) the performance of the proposed technique with various channel state information (CSI) has been analyzed and shown their results using some graphs.**

Keywords- Cooperative-MIMO; Energy Efficiency; Mobile Adhoc Network, Optimized Energy Efficient Routing

I. INTRODUCTION

In this very recent year the Energy issues and the cost based routing in Mobile Ad-hoc Network has become a very important topic in the area of research. A mobile Ad-hoc network is a self-configuring and a collection of some independent mobile nodes where the network is very much infrastructure less and the location of each node can be changed dynamically whether the nodes can be any type of mobile computing devices made up of necessary communication protocol. The mobile Ad-hoc network is designed as an infrastructure less network where the nodes don't require any centralized support and they do have limited power capacity and here the power consumption constraint is a very important issue due to the limited power capacity of each node and the short range radio propagation that is the functional area of this Mobile Ad-hoc network [1]. Applications of MANET:

Some of the applications of MANET are: It is used in the Military battlefield where a soldier can get advantage of communicating with another soldier during the battlefield and they can send some important information to the Military vehicles and Headquarters also. When some people of an organization are working in a particular project then they need to interact with each other with the help of some computing devices so in that business environment the collaborative work is very much necessary during an outside meeting of a particular project so then MANET will be a efficient way of information exchange between a project team. The application of MANET has been implemented in the local level also where some nodes such as notebook computers are connected in a multimedia network for exchanging some information among participants e.g. conference or classroom environment. Another local level example is a home network which can be a good platform for sharing of information over a Mobile Ad-hoc network. In the field of personal area network where the Bluetooth which is installed in some nodes, in the personal area network those nodes might be cooperative with a person so usually the Bluetooth uses a very short range radio frequency transmission and propagation so it is a useful application of MANET. A simplification of the transmission of radio wave between various mobile node such as laptop and mobile computing devices is done by Bluetooth. For various rescue operations such as flood, fire, terrorist attacks and various disaster management operations the infrastructure less non-existing reliable network communication is needed [2].

Energy Issues in MANET: The issues which are related to the energy consumption of Mobile Ad-hoc network can be mapped at different layers. In the recent years various researchers have focused on the energy optimization techniques in the route cost based MANET. The main issue which is related to a mobile node is that has a very much limited power capacity. In the area of mobile Ad-hoc network the nodes must be portable so that it should carry light weight designed tools and the maximization of power for the battery source will make the node less portable. Apart from these a MANET requires an infrastructure less multi hop routing and communication with limited usage of energy, band-width and CPU with some security so these constraints put some challenges in the field of MANET routing protocol design[3].

This paper focuses on the detailed discussion about the proposed Optimized Energy Efficient Routing Protocol. The paper is organized as follows. Section III gives review of the proposed system and the section IV provides the implementation details of the proposed system, here the literature survey on the previous related work is described in section II and evaluation of the proposed system is done by comparing the OEER protocol with existing Channel State Information's (CSI). The implementation results of the proposed system along with different parameters has been shown by graphs.

II. Related Work

The proposed system introduces a framework that ensures Energy –efficiency for large scale MANET system using the concept of route cost maintenance. Roy [4] has introduced system that focuses on the optimization of energy consumption in MANET and the author has adopted three techniques to conserve energy by reducing the number of route request message and two different techniques. And presented the outcomes of the techniques using graph. Gallina et al [5]. Has introduced a framework that focuses on the optimization of time and energy cost of MANET and they have adopted Markov Design Process (MDPs) , probabilistic process calculus , and Probabilistic model checker PRISM and they have analysed how time and energy costs vary when pursuing different power control strategies and the outcomes were evaluated using graphs. Kumar et al [6]. Has introduced a model that focuses on the evaluation of the performance of DSDV, DSR and AODV routing protocols with respect to energy consumption where the outcomes are evaluated using some graphs. Shrivastava et al [7]. Has introduced a model that focuses on methods used in energy based algorithms to reduce the power consumed in the communications between ad hoc network nodes the authors have developed a E-AODV model based on AODV protocol where the outcomes are evaluated using graphs. Fahmy et al [8]. Has introduced a framework that focuses on the performance of the proposed and improved PEEBR algorithm and the performance of the proposed and improved PEEBR algorithm is evaluated in terms of energy consumption efficiency and throughput compared to two state of art Ad-hoc routing protocols and the outcomes were evaluated using graphs. Prabu [9] has introduced a framework that focuses on energy efficient routing the author has adopted new routing algorithm named Energy Saver Path routing Algorithm using Optimized Link State Routing (ESPR_OLSR) where the outcomes have been shown using graphs. Anil [10] has focused on the standard routing schemes as well as some of the significant recent studies understand the level of effectiveness in the prior studies. Finally, the research gaps that are being analyzed among the research communities have been discussed over here. Anil [11] illustrated a protocol named "Energy Efficient Routing Cost Protocol (EERC)" for the minimization of the route cost and the energy efficient path. This paper also describes different routing protocols like AODV, DSDV and evaluates and analyses their result using some graphs.

III. Proposed System

Optimized Energy Efficient Routing (OEER) which is designed to achieve a better system performance for energy optimization and delay operations. In the mobile Ad-hoc network or the wireless communication the efficient use of bandwidth or the spectral efficiency can be achieved by one technique which is Multiple Input Multiple Output technique (MIMO), in the field of cellular network and the mobile Ad-hoc network the employment of MIMO can be done but there are some disadvantages of MIMO over mobile Ad-hoc network as the requirement of some complex transceiver and signal processing techniques are there for the employment of MIMO to each node of a MANET. As MIMO requires a very complex environment for signal processing as well as it consists of multiple antennas which cannot be deployed with a single node of MANET as the nodes are very small in size with a very limited power resources so the power consumption will be very high in case of adoption of the MIMO application in the field of wireless and mobile Ad-hoc network, so here the concept of cooperative MIMO has been introduced, in this concept we can see that each node of the MANET network is associated with a single antenna , so here a virtual MIMO technique has been develop which supports space-time processing . It has been presented that the cooperative MIMO achieves better energy performance results as compared to SISO (Single Input Single Output) system and achieve a better goal for the system performance solutions. Here this cooperative MIMO is used in the OEER protocol with space time coded diversity techniques to maximize the channel capacity and to combat the fading channel. Performance gain can be achieved by uniform power allocation among nodes with optimal energy distribution technique to optimize the link outage probability of a fading channel. This paper focuses on the proposed cooperative MIMO technique with uncoded spatial multiplexing where the discussion is about the act of carefully choosing the cooperative nodes and the Energy/bit rate distribution have been induced to optimize the bit-rate error of the system and Channel Models.

It is presumed that the source node can make a virtual MIMO with respect to its neighbor nodes where the source node including all the neighbor nodes will carry a single antenna the destination node can be a large size node so that multiple receiver antenna can be implemented. For application purpose it can be used in the battlefield where multiple soldiers with one small carry-on communication unit need to communicate or transmit some data to a destination which is mounted on a vehicle. It has assumed here that a source node has N-1 neighbors and we want to select M out N nodes to establish a Virtual MIMO system where source node will also be included. The destination node is considered to have T no of antennas where $T \geq N$. Suppose the distance between source node and the destination node is L_1, and the neighbors of the source node will be randomly deployed within a radius of L_0, from the source node here it is assumed that $L_1 >> L_0$ so that calculating the distance between each cooperative nodes and the destination node can give approximate the value of L_1. Here a

statistical model called *i.i.d* frequency-flat Rayleigh with parameter σ^2_0 plus path loss with path loss exponent of 4 has been discussed. The channel has considered as a constant within duration of its coherence time. In the field of wireless communication it is easy to obtain high correlation between propagation paths by blocking with a same obstacle or shadowing. In this paper the correlation effect which is caused by shadowing has been discussed one model for the channel correlation between any two nodes has been discussed over here.

$$\alpha = \delta^{\frac{l}{L}} \quad (1)$$

Where α is the correlation between two nodes which are apart from each other by a distance of l and δ is the correlation between two nodes which are separated by a distance of L.L and δ can be measured by field test and by the values of these two variables it can be easy to evaluate the correlation between any two nodes.

It has been assumed that in the proposed virtual MIMO system the time slot and the time synchronization among nodes can be achieved by beaconing (as in IEEE 801.22). Suppose a virtual MIMO is created by M no of cooperative nodes and X=[X1, X2 … XM] which denotes the transmitted vector and Y= [Y1, Y2 … YM] which denotes the received vector at receiver with T no of receive antennas the received vector Y after match filtering can be discussed below with the following equation

$$Y = G X + m \quad (2)$$

Where G is represented as a channel matrix between the cooperative cluster and the destination node and which has a dimension of T x M and $m = [m_1, m_2 \ldots, m_T]^l$ which represents the i.i.d Gaussian noise with zero mean value with variance σ^2_m .

A. *Local Distribution and Long-Haul Transmission*

It is assumed that the total no of source node has B_0 bits to be sent to the destination here using the proposed mechanism for the node selection the M nodes are selected to perform the cooperation technique after that M sub streams are formed by the source node and the source node distribute the consecutive sub streams to the M selected cooperative nodes such that each cooperative node should have one distinct sub stream, a time slot duration τ is allocated with an assumption and here the TDMA (Time Division Multiple Access) is employed for the distribution of time slot and for the distribution of source information delay has been also induced.

B. *Spatial Multiplexing technique with ZF-SIC*

This section discusses about the spatial multiplexing and here it is assumed that the receiver records a perfect channel state information here employment of spatial multiplexing has induced in order to exploit the channel capacity of MIMO system. It has been considered that the source node first separates the incoming bits into M sub streams and then the source node distributes each sub stream among N cooperative nodes. After getting transmission acknowledgement each node transmits a bit stream to the destination node with other cooperative nodes via virtual MIMO structure then the M no of bit streams can reach the destination node from the source node. So here in this MIMO like transmission many receiver design strategies have been introduced for the destination node to detect the original bit stream. Linear receivers (Zero-facing or MMSE), V-BLAST (Order Successive Interference Cancellation) and Successive Interference Calculation (SIC) these receivers have been designed for the MIMO transmission. This paper provides the necessary information related to successive interference cancellation with fixed detection order as well as ZF at each detection stage. For the ease of simplification we presumed that all the previous research and based on that research the decisions related to ZF-SIC are correct. Here one channel matrix C has been decomposed where C=HZ where H is an unitary matrix with orthogonal columns here we have shown one equation for the modified received signal vector

$$\hat{y} = H^C y = Tx + H^H n = Tx + v \quad (3)$$

Where v has the same statistics as m, here H is a unitary matrix with orthogonal columns and T is an upper triangular matrix.

IV. IMPLEMENTATION

Here in this paper the local distribution and the long haul transmission have been considered together for the implementation. The optimization problem has been divided into two stages including the energy consumption and the delays. For the energy optimization problem N possible candidates have been taken as well as the optimal subset of the cooperative nodes are represented as σ which considers M nodes for the energy optimization with corresponding power/bit allocation for each of them here the power per bit has been denoted by E_i and B_i where i = 1……n. The total end-to-end energy and total end-to-end delay has been denoted by E_{tot} and d_{tot} respectively. And the maximum allowable values are given by E_0 and d_0 and the overall equation for the optimization of the energy problem is given below.

$$\max(\sigma, M, E_1, B_1) l^2_0$$

Such that…

$$\sum_{t-1}^{M} E_i = E_T; \quad (4)$$

$$\sum E_{tot} = \sum_{E_{tot}}^{(2)} + \sum_{E_{tot}}^{(1)} \leq E_0; \quad (5)$$

$$d_{tot} = d_{tot}^{(2)} + d_{tot}^{(1)} \leq d_0; \quad (6)$$

$$0 < M \leq N; \quad (7)$$

For finding σ, M_i, E_i , B_i where i = 1…..n , it is found to be a huge problem when there is a necessary search which is very much exhaustive in nature so here to overcome this complex problem one three steps algorithm has been introduced. So in this proposed OEER protocol first the energy and the delay are induced during the local distribution stage after that this

experiment is conducted for the long haul transmission and the given subset of the cooperative nodes which is denoted by σ at the source node after that the resource allocation to achieve the optimal solution at the destination node has been presented. After that for the given source nodes and its neighbors a algorithm named heuristic has been introduced for the selection of a subset which consists of cooperative node combinations for the better functionality at the receiver node side the computing results should be 120 which is have relation to the power/delay depletions for each of the combinations, the best possibility for node combination selection is decided to compute the best possible results which satisfy the total continuous delay/power constraints. During the local distribution estimation period the source transmits the data packet to the consecutive selective nodes in this period of time the energy for the local distribution is composed of transmission energy which gives the certainty for a reliable communications in between source node and a respective cooperative node. This transmission energy is the sum of the energy depletions of all the circuit blocks. Though the transmission between source node and the destination node occurs in the form of data packets so that it is assumed the source node has K_i bits within a packet to be sent to a cooperative node i and in the local distribution stage a fixed M_0-ary QAM is used for a coherent modulation/demodulation scheme here a rectangular M_0 = I.Q QAM signal can be treated as pulse amplitude modulation, where this pulse amplitude modulation (PAM) is considered to have two independent signals on phase quadrature carriers i.e. l-ary PAM and Q-ary PAM the two rectangular PAM signals are demodulated uniformly at the receiver end and the probability of faultiness for the original signal is given below.

$$SER = 1-(1-SER_I)(1-SER_Q), \quad (8)$$

Here in this above equation the SER_I and the SER_Q are the symbol error rate for two types of PAM signal. Here an approximate estimation of SER has been shown below.

$$SER \approx 4O\left(\sqrt{\frac{3\beta}{M_0-1}}\right) \quad (9)$$

Where O is the Gaussian tail function and β is the corresponding signal to noise ratio for the transmission between nodes i, given by

$$\beta = \frac{\phi_i E_i^{(1)}}{N_0}, \quad (10)$$

In equation (10) ϕ_i is the channel gain and E_i is the respective transmission power per symbol and N_0 is the noise power.
When a symbol error rate threshold SER_T is required for the local transmission then the estimated transmission power for the local transmission to node I is given by

$$E_i^{(1)} = \frac{(M_0-1).No}{3\phi_i} \times \left[O^{-1}\left(\frac{SER_t}{4}\right)\right]^2 \quad (11)$$

Here the energy distribution in the local transmission is shown as

$$E_{tot}^{(1)} = \sum_{i=1}^{N}\left(\frac{S_b L_i}{b_0} \times \left[E_c + E_i^{(1)}\right] \times I(i)\right), \quad (12)$$

We can obtain the value of E_{tot} by this equation where L_i/b_0 is the number of symbols per packet when node I is considered as a source node and the indicator function I (i) is given as

$$I(i) = \begin{cases} 0, When\ node\ i\ is\ the\ source\ node; \\ 1, When\ node\ i\ is\ not\ the\ source\ node; \end{cases} \quad (13)$$

It is assumed that the TDMA is used here in this experiment for the local distribution where the fixed symbol duration is assumed to T_s so the total delays associated with the transmission to the each of the N cooperative node is given by

$$T_{tot}^{(1)} = \sum_{i=l}^{M} \frac{L_i}{b_0} \times T_8 \times I(i) \quad (14)$$

A. *Long Haul Transmission Optimization*

This Long Haul Transmission Optimization technique has been induced in the field of OEER for finding the power/bit resource allocation for the cooperative selected nodes with the transmit power constraint and the total bit rate constraint Here the transmission power constraint and the total bit rate constraint have been denoted by T_P as well as T_B respectively. Therefore the optimization problem for Haul transmission is given by

$$\max(T_P, B_T) l_0^2$$
$$s.t \sum_{i=1}^{M} E_i = E_{T;} \sum_{i=1}^{N} \log_2(B_i) = T_B \quad (15)$$

Therefore in this technique if an exhaustive search algorithm is employed after that repeating many processes for all the possible node combinations the largest l^2_0 can be achieved.

V. RESULT ANALYSIS

The proposed OEER protocol graphically simulated in mat lab and compared according to the Channel State Information.

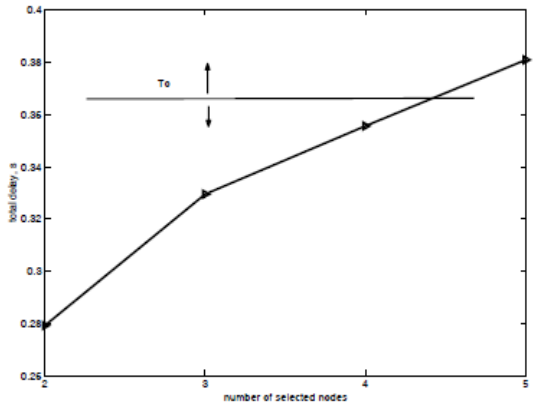

Figure 1 Proposed OEER Technique with perfect CSI; SNR = 21 dB

In this part, performance analysis of the proposed node selection algorithm is represented in the form of selected numerical result by considering the system constraints like delay and energy consumption. We select K = R = 6, which convey that there is 6 receive antennas in both source node and destination node which are 6 potential cooperative nodes. D1 is the distance labelled between the source and the destination nodes and its value is 100 m, and the cooperative cluster radius is D_0 and its value is 10 m. in the whole process of documentation the system bandwidth is considered to be 10 KHz, the path loss exponent value is used to be 4, 250w is assigned to the circuit power. And data rate b_T is fixed to 14 bps/Hz. Fixed modulation size b_0 is considered has 4 During the local distribution. In 256-QAM for each node, used size of QAM constellation is maximum. At last, the parameter $\beta = 0.3$ and D = 10 m is used by the correlation caused by shadowing unless otherwise stated.

Actually the necessity of the demonstration is to consider the cooperative selected nodes in a challenging environment. In this Figures. 1 and 2, it has left the system constraints E_o and T_o by considering them has infinite and proposed the technique by employing the perfect CSI. Form the above graph it conveys that presence of delay and energy constraints in the system i.e. more stringent the constraints is, the availability of the cooperative node to select is minimized. So, it infer that the two system constraints energy consumption E_o and delay T_o, play major roles in the selection of cooperative nodes.

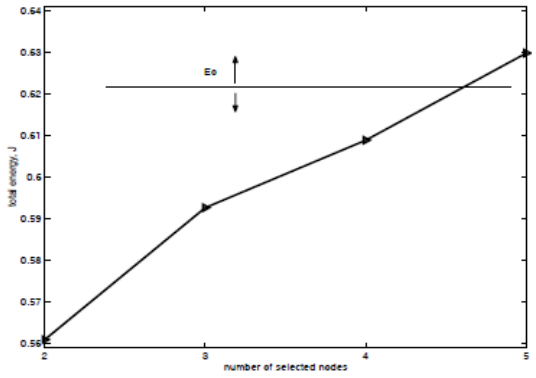

Figure 2 OEER Scheme with perfect CSI; no constraints; average SNR = 21dB.

Along with this, it is clearly visible that the overall performance of the system could be somehow dependent on the system parameters, i.e., E_o and T_o, which helps in the selection of number of cooperative nodes which are participate in the cooperation. For example, optimal number of cooperative node are not able choose if E_o and T_o are small and output the degraded overall system performance.

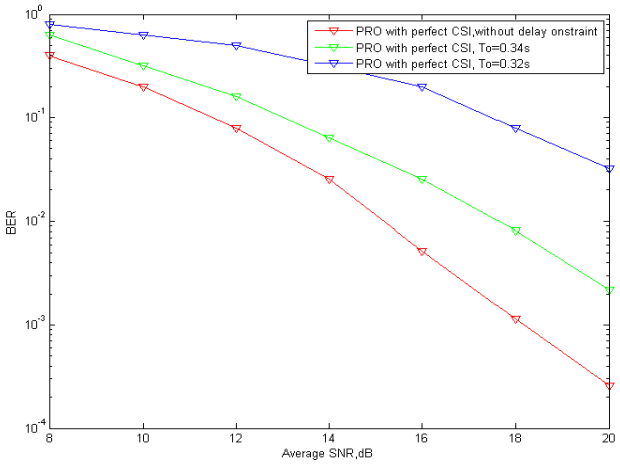

Figure 3 Analysis of BER

In Fig.3, represents the performance of the proposed Optimized Energy Efficient Routing technique and the average SNR without or with different delay constraints. As shown in the above graph system performance is achieved best if the delay constraint not considered, i.e., T_o is infinite. But, as the delay constraint becomes stringent, there is substantial degradation in the system performance, as shown in the figure. The reason beyond this problem is we are unable to choose the optimal set of cooperative node when the delay constraint is present, which are used to achieve the best performance, and there is exists an inverse relation between the stringent of constraints and the cooperative nodes and direct relation between the nodes and the system performance so, as the increase in the constraint the number of nodes become less and the performance is degrades. In this figure it is shown that the local distribution and the long haul transmission stages in a cooperative MIMO system of a mobile Ad hoc network can be under restriction by many system constraints and many constraints can affect the system performance also. In Fig.4, performance comparison has been shown with the proposed algorithms under different channel correlation levels. When the channel correlation level is same best performance is achieved from the proposed technique with perfect CSI since it uses the perfect Channel State Information's for achieving the cooperative node selection. In the above figure we Compared performance of the proposed technique with perfect CSI with the exhaustive search, it shows there is a small drop in performance compared to other and also demonstrates the effectiveness of the proposed algorithm.

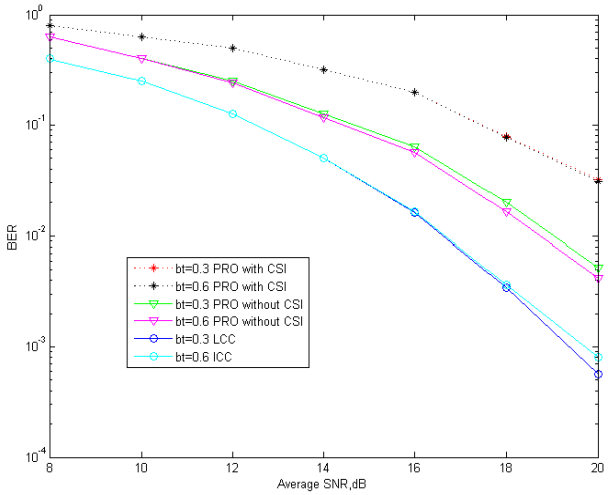

Figure 4 Performance comparison

In same time when CSI is not available then also we can implement the proposed node selection algorithm using the channel correlation information from the modified proposed technique with no CSI and also with the LCC algorithm. From the figure we notice that there is overlap in the performance curve due to exploration of the same channel correlation information by the two algorithms. Pervious discussion conveys that LCC algorithm less complex compared to the proposed technique without CSI. As shown in Fig. 6.19, since the proposed technique with no CSI and LCC algorithm has still some degradation in system performance compared to that of proposed technique with perfect instantaneous CSI. But the non-availability of the instantaneous CSI in practical leads generates the algorithms which can be able to exploit the channel correlation, the channel correlation varies very slowly with respect to the channel state information. In this particular research area it is also experimented that if the channel correlation increase then the whole system performance can be affected with degradation. It is also observed in this research that the performance gap between proposed OEER technique with perfect instantaneous CSI and LLC and the proposed techniques without CSI decreases when the correlation level increases. So that It can be said that the proposed technique without CSI and the LLC algorithms can give efficient performance results with high channel correlation. In fig. % it is analyzed that the validation of the system performance which is based on correlation. It is also can be observed that the system performance is inversely proportional to the channel correlation. there is no necessity in the cooperation of the all the K nodes and due to the negative effect of the correlation the system try to choose less number of nodes for cooperation when the correlation level the graph has represented below.

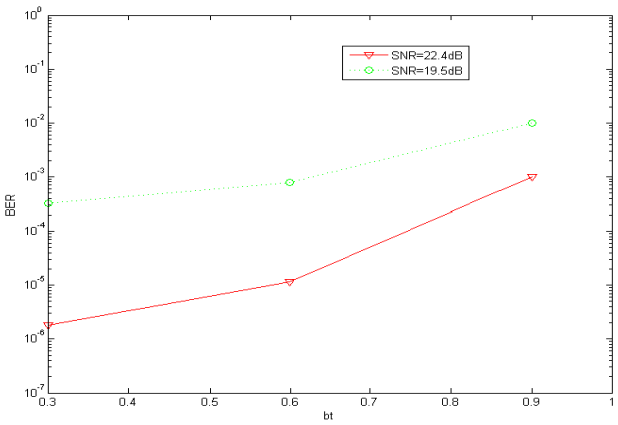

Figure 5 Analysis of channel correlation for proposed technique

VI. CONCLUSION

this paper proposes an Optimized Energy Efficient routing protocol (OEER) for mobile Ad-hoc network and the details of the proposed protocol is discussed and analyzed the over here it presents the a brief overview of implementation portion where the discussion about the OEER protocol that uses some strategies like Cooperative MIMO techniques , Local distribution and Long Haul Transmission Techniques. Here in this paper the analysis of energy depletion has graphically represented and the comparison of proposed OEER protocol, analysis of channel correlation with respect to Channel State Information are discussed and this paper analyzes the energy consumption and retransmission attempt with some graphs. This work will be very much useful in future for the analysis of some energy efficient routing protocols.

VII. REFERENCE

[1] R.K.Chauhan and A. Chopra, "Energy efficient routing in mobile ad hoc network with capacity maximization", IJCA special issue on mobile ad-hoc networks ,2010

[2] P. Goyal, V. Parmar, and R Rishi, "Manet: Vulnerabilities, challenges, attacks, application", IJCEM International Journal of Computational Engineering & Management, Vol. 11, pp.32-37, 2011

[3] M. Fotino and F. D. Rango, "Energy Issues and Energy aware Routing in Wireless Ad-hoc Networks", INTEC Open Access publisher of scientific Books and Research, University of Calabria Italy, Vol. 1, No. 1, pp. 156-167, 2011

[4] N.K.Ray and A.K. Turuk, "Energy Efficient Techniques for Wireless Ad Hoc Network,", 2010

[5] G. Lucia, T.Han, M.Kwiatkowska, A.Marin, S.Rossi, and A.Spanò, "Automatic energy-aware performance analysis of mobile ad-hoc networks", In Wireless Days (WD), IFIP, pp. 1-6, 2012

[6] A.Kumar, M.Q.Rafiq, K.Bansal,"Performance evaluation of energy consumption in MANET", International Journal of Computer Applications, Vol. 42, No. 2, 2012

[7] P. Shrivastava, A.Sinhal, and A.Gupta,"Performance Improvement of Mobile Ad-hoc Networks through Energy Conservation Scheme", International Journal of Computer Applications, Vol. 71, No. 2,2013

[8] I.M.A.Fahmy, L. Nassef, and H. A. Hefny, "On the Performance of the Predicted Energy Efficient Bee-Inspired Routing (PEEBR) ", International Journal of Advanced Computer Science & Applications, Vol. 5, No. 4, 2014

[9] M.K. Prabu and A. Subramani, "Performance Analysis of Energy Efficient Routing for Mobile Ad-hoc Networks" Retrieved 10 January, 2014

[10] Anil G. N., A. V. Reddy, "Investigating the Energy-Preservation Techhniques in Routing for MANET", International Journal of Engineering Research & Technology (IJERT), Vol. 3 - Issue 12, 2014

[11] Anil G. N, Dr. A. Venugopal Reddy, "Schema for Ensuring Energy Efficiency for Performing Routing in MANET", International Journal of Engineering Research & Technology (IJERT), Vol. 3, Issue. 12 2014