Energy-Efficiency in Mobile Ad hoc Network using Artificial Neural Networks

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Abstract— The main aspects of communication in mobile ad hoc networks are to provide efficient energy using routing protocol. Traditionally, it consume more time and not able to receiving data packets at destination and consume more power for sending information. Still the issue persists. The main aim is to reach the data packets in their concern base station or vice versa. However, it is required to analysis and performs techniques using data packets. Enhancement of communication depends upon the energy efficiency is applicable. Further, in our research paper it is optimize using neural network techniques. In this research paper, we have used unsupervised learning technique i.e. SOFM (Self Organizing Feature Map) Neural Network. It can be implementing in various direction-finding protocols. These protocols are for the most part deliberation of enhanced quality and consume less energy as evaluate to the previous phase condition. The model results demonstrate the protocol implementation and their results. Overall, it can provide the enhanced communication way and boost the network lifetime in the ad hoc network.

Keywords—Mobile Ad-hoc Network, Quality of Service, Energy Efficieny, Artificial Neural Network

I. INTRODUCTION

Mobile Ad-hoc Networks is multi hop network which is consists of the large network size and collaborative work with the devices. This network does not have infrastructure and no fixed access points for holding the data packets. Each neighbouring nodes can forwards their data packets to their destination nodes. Wireless ad hoc network is collection of heterogeneous network which holding the temporary network nodes. MANETs are collections of nodes linked with wireless points. All links dynamically self organizing. All nodes use temporary network topologies to reach its destination points [9]. All mobile nodes are infrastructure less which can change their routing information is some time interval. Changing its information affects their connectivity of the network. MANET nodes can able to performing their route repairing and route discovery. Node can relocate the data packets with each other also communicating with multiple data packets. Hence it is called multicast routing in MANET. Nodes can transmit and obtain their data packets numerous times.

1.1 APPLICATIONS

In Mobile Ad Hoc Network uses variety of communication that can fulfil their requirement accordingly. Ad-Hoc network can be auxiliary confidential into various sectors that are in Mobile Ad hoc Networks (MANETs), Vehicular Ad-hoc Network (VANET), Wireless Sensor Networks (WSNs), Disaster Ad hoc Networks[26].

1.2 ISSUES IN MOBILE AD-HOC NETWORKS

In mobile ad hoc network (MANET) holding the various problematic conditions such as delaying the source packets to destination, lack of energy between the wireless devices, less secure environment to handle the wireless ad hoc networks. In Addition, there is lack of dropping routing packets which decrease the performance of the networks. Generally, in the ad hoc network is changing their network topology over the time [26]. Also having limited bandwidth channels transmission which is looses the data packets. There is no centralized environment provided by the wireless ad hoc networks.

1.3 AD HOC NETWORKS PROTOCOL

Mobile Ad Hoc Networks can provide information sharing without any base infrastructure where the several nodes can combine and share their information and exchange their data packets and forwarding to it very quickly. Nodes can send or receive their data packets from their concern mobile host node. In the MANETs are usually confidential into their type of categories: Proactive, Reactive and Hybrid [27].

A. Proactive Protocols

Proactive protocols are the table derived which sense the routing which is built by the several nodes depends upon their specific routes. Each node which is maintains the routing information with the facilitate of direction-finding table. If any changes in the topology which gives immediately sends their information in their network to their concern nodes and update it quickly. There is usually used protocol which exists in proactive protocol which is Destination Sequenced Distance Vector-(DSDV) and FSR based protocol [1]. There are also lots of proactive protocols which are commonly used in MANET.

B. Reactive Protocols

Reactive protocol which provides routes when any node is tries to send any data packet. In this routing approach which is depends upon their two type of involvement one is route discovery and another is route maintenance. The route

discovery model the source node which send the requests to their neighbour's nodes with the help of broadcasting a message in the network. In another part route maintenance which is acknowledgement to their concern node. In this various protocols exists in the reactive protocol but commonly protocol used in Dynamic Source Routing-(DSR) and Ad Hoc on Demand Distance Vector-(AODV) etc [4].

C. Hybrid Protocols

These hybrid protocols provide the mixture of proactive and reactive protocols [6]. There are commonly used protocol which exists in hybrid protocol Zone Routing Protocol (ZRP) and etc [5]. These types of protocols which are also having issues in MANET approaches.

II. SOFT COMPUTING

Soft Computing deals with the defined models where estimated solutions can be achieved in better or organized manner. Soft Computing is new concept which is mainly concerned with the better solution with great conviction experience. It is partnership with the various kinds of fields. Soft Computing mainly uses the combination of the Neural Network, Genetic Techniques, Fuzzy logic System, Hybrid System.

2.1 Artificial neural network

Artificial neural network-(ANN) definite as in sequence processing image that is encouraged by the way biological nervous systems such as brain, process information. This model tries to replicate only the mainly necessary functions of the mind [7]. The solution part of ANN is the construction of its information dispensation scheme. ANN is self-possessed of a huge figure of extremely organized processing rudiments operational in unity to resolve definite inconvenience.

In this research paper mainly work on end to end delay using neural network technique (Rest of the paper is organized as follows, Section I contains the introduction of mobile-ad-hoc networks , Section II include the opening of soft computing techniques, Section III contain the related work of mobile ad hoc networks, Section IV contain the dilemma formulation of ad-hoc-networks., section V explain the simulation metrics of ad hoc network, Section VI describes results and analysis, Section VII contain conclusion and future work.

III. RELATED WORK

In this section many protocols used and developed. This can be further implementation according to their requirement. In the concept of Mobile ad hoc Network using soft computing there are various type of work done previously. These works is based on implementation on their present scenarios. The scenarios is based on real metrics exists in mobile ad hoc networks.

Satish K Shah at el presented the "ANN based Optimization using ADOV reactive routing protocol". They describe that information update at some fixed time interval can cause the unnecessary traffic in wireless network. In this using soft computing technique ADOV routing protocol is proposed to determine the frequency of hello interval to improve the performance of the network [12].

Ting Lu at el proved the QoS Multicast Routing which is based on ANN genetic algorithm to enhance the energy efficient metrics of MANET. In this routing algorithm which enhanced the performance of energy efficient delay constrained multicast routing algorithm [13].

Jyoti Prakash Singh at el presented the Delay Prediction Method in MANET using Artificial Neural Network. In this research paper presented the delay prediction using Radial Basis Function and Generalized Regression Neural Network. The Generalized Regression Neural Network predication was best results as compare to the Radial Basis [14].

Satyananda Champati at el presented multi objective technique using Genetic Algorithm which consider five QoS metrics in Mobile Ad Hoc Network included i.e. Bandwidth, Delay, Jitter, and Packet Loss. The model incorporates a fuzzy based selection technique for initialization of quality of service parameter values [10].

V.M. Harnal and V.R. Budyal proved QoS Routing in MANET which main purpose to give better quality of service to the users. They optimized using neuro fuzzy system. This will optimized real time communication in mobile ad hoc networks [15].

M. Marimuthu et al had presented comparative study of fuzzy based routing protocol. In this paper any QoS aware routing protocol should consider maximum parameters in order to be deployed in real time offer expected benefits. According to fuzzy based routing protocol they presented their Quality of Service constraints such as bandwidth, delay, jitter, link expiration time and energy level. These constraints are further need to research and give the better Quality of service [16].

Eyosias Y. Imana et al had presented the paper "Proactive Reputation Based Defense for MANET using neural networks". In this paper author main consideration about the radial function neural network is mapping between the states of the various node attributes. The RBF-NN can be used to predict the reputation results better than the previous work which enhances the security constraints in mobile ad hoc network [17].

Lyes Khoukhi et al had presented the paper "Intelligence QoS management for multimedia service support in wireless mobile ad hoc network" In this paper the author presented the main issue concern about the multimedia service congestion to support both audio or video format. They divided into three contributions fuzzy QoS 1, 2, 3. According to these contributions the data is going into these three phases which enhance the QoS performance [18].

Siddesh.G.K, et al. in 2011 proposed a routing protocol in ad-hoc wireless network using software computing technique

like neutral's network, fuzzy logics and genetic algorithm. Performed simulation uses various existing protocols like power aware routing protocol, proactive, reactive and hybrid routing protocols. Authors use software computing share to improving the protocol performance in very dramatic terms, establishing the link between the nodes in minimum time and find the optimal route to a large network [24].

X. S. Asha Shiny and R. Jagadeesh Kannan in 2015, they proposed an Energy-Efficient-Clustering Protocols based on Self-Organizing Maps (EECPSOMs) in MANETs. The proposal program can be clustering sensors-no des depends on additions parameters such as energy-levels and weights of sensor nodes. Self Organized Mapping (SOM) helping in formatting cluster, so that nodes with higher-energy attracts nearest-nodes with low-energy levels. Also, the method enabling to forms energy-balanced cluster and distributes the energy consumptions in an equivalently manner. And EECPSOM results are proving the minimizing energy using and make energy efficient to lifetime of the networks [29].

Hui Cheng et al had presented the paper "Dynamic genetic algorithms for the dynamic load balanced cluster problem in mobile ad hoc network". In this paper author consider the energy conservation metric. In this clustering algorithm should efficiently adapt to each topology change and produce the new load as possible which reduces the overhead [19].

Shangchao et al describe the "Fuzzy Controllers Based Multipath Routing Algorithm in MANET". In this paper author presented fuzzy controller based multipath routing algorithm in mobile ad hoc network (FMRM). The FMRM algorithm is to help to reduce the reconstructions of ad hoc network which enhanced the quality of service aspects [20].

Arindrajit Pal et al had presented the paper "The Path Length Prediction of MANET using Moving Average model". In this paper main focus about the path length between sources to destination nodes. This parameter is based on predict values which increases the quality of service of mobile ad hoc network [22].

Ghaidaa Muttasher et al had presented the paper "Improving Ad Hoc Network Behavior Using Clustering Technique with NS2". In this paper they analysis the performance of MANETs using clusters. In Addition, compared with CBRP and Other Protocol like AODV, DSR, DSDV. It mainly concern with PDR, Average throughput, End to end delay and Dropped Packets metrics [8].

Mercy Rani A had presented the paper "An efficient Position and Distance Based Clustering Approach in Mobile Ad Hoc Network". In this paper it mainly used clustering scenarios with comparable with AODV protocol. Clustering approach provides better performance and further research is applicable [11].

Lakshman et al presented the research paper "Analysis of performance improving parameters of DSDV using ns-3". In this research paper author represented the minimize effective delay analysis in mobile ad hoc network. Author also considers the other factors such as PDR, Throughput, and Normalized Routing Load [3].

IV. SELF ORGANIZING MAPS

In the self organizing feature map is one of the type of artificial neural networks. It is type of learning network and get trained with the help of self organizing map. In the SOM we are basically using to detect the problem in the feature map which can work with the mobile ad hoc networks.

As the working of self organizing feature map (SOFM), it is working with two phases training and mapping mode. In the first phase of training and build their map according to their scenarios. SOM basically uses the components i.e. neuron or nodes. It get functioned and represented in the form of vector shape. It also represents their hexagonal and rectangular grid views. It works on their high dimensional input to lower one. The main idea is behind to find out the nearest nodes according to map.

The basic architecture of SOFM can be seen in Fig. 1. In this figure the input neurons are represented. The set inputs are x_1 to x_n. These inputs are connected to the output neurons which are represented as y_1 to y_n. The topological structure of neighbourhood neurons is either rectangular grid or hexagonal grid form. These two of grid distribution is done to get the optimized output from the winning node in the SOFM neural network. Both topological structures are depicted in Fig.2 and Fig. 3 respectively. The winning neuron represented which placed in center with # symbol form and other neighbourhood neurons are represented in * form in both topologies. If we talk about the nearest neighbouring neuron then in case of rectangular grid, there exist eight neighbouring neurons but in other case i.e. in hexagonal grid, there are only six neighbouring neurons.

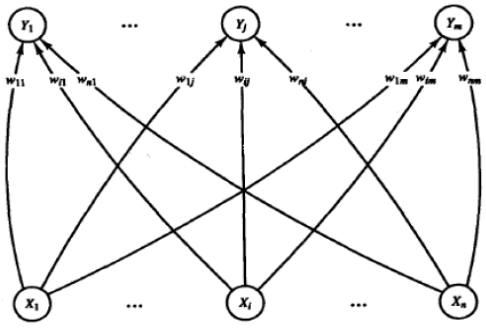


Fig. 1 Architecture of self-organizing feature map neural network

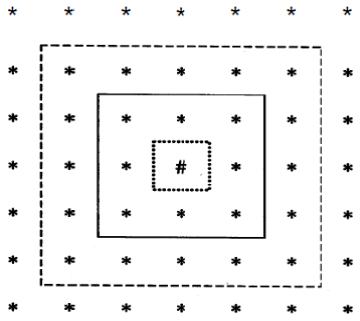


Fig. 2 Grid topological view (# defines winning node and * defines the neighborhood nodes)

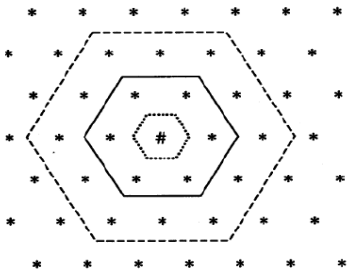


Fig. 3 Hexagonal topological view (# defines winning node and * defines the neighbourhood nodes)

SOM ALGORITHM

Step 0. First initialize weights i.e. w_{ij}, and then set topological neighboring & learning rate parameters.
Step 1. Repeat steps 2 to 8 for false stopping condition.
Step 2. For each binary input vector x,
do steps 3 to 5.
Step 3. For each j,
compute: $D(j) = \sum(w_{ij} - x_i)^2$
Step 4. Find index J such that
D (J) is a minimum.
Step 5. For all units j within a specified neighborhood of J, and for all
I: $W_{ij}(new) = w_{ij}(old) + \alpha [x_i - w_{ij}(old)]$.
Step 6. Finally update learning rate.
Step 7. Reduce radius of topological neighborhood at specified times.
Step8. Normally the stopping condition contains the fixed number of iterations or until the radius becomes zero or the weight matrix reduces to a small value.

PROPOSED TECHNIQUE

In this technique we are basically implement the SOM with working of energy efficiency with the help of routing protocol of mobile ad hoc networks. According to this, we mainly improvement of the network lifetime in the MANET networks with better quality of data packets with reliability. So, first we need to understand the basic functionality of selection of clustering. Based on clustering it will calculate the energy levels and select the cluster head. According to time interval round it will selected the particular cluster head with their energy levels.

Initialization

The first step is to initialization of nodes with their same energy levels. Then it will further select and calculated their cluster head properties.

Cluster work

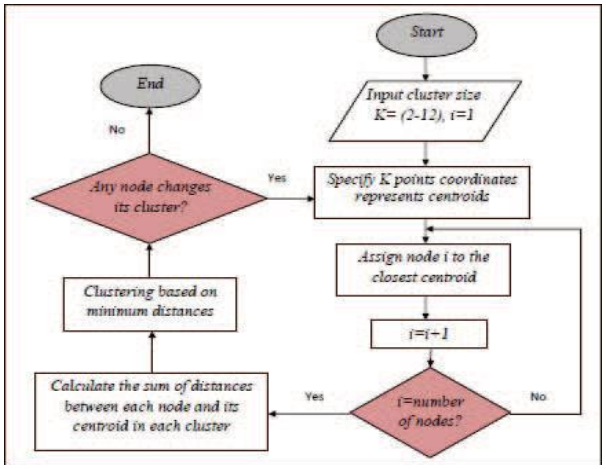
The next process to implement the cluster is that cluster to work in particular network. It can visualize the cluster in the form of draw map. It is able to perform to reduce and rebuild according the scenarios in the network using SOM. Initially it can consider the x and y point and coordination according to their energy levels. In order to calculate the weight matrix needs some mandatory phase. It is called the base station which has to select the number nodes which have similar energy levels. So it can partition according to their regions and it can select nearest node in specific region. Base station also calculated and gets the neighbouring cluster information.

Cluster Selection

The next step is to self the CH from the nodes in the network. This can be select according to the parameter. In this research paper our main concern is energy efficiency.

Data Transmission

After all the process data is transmitting in the specific model.



V. RESULTS AND ANALYSIS

There is Intel lab dataset [29] has been taken as input values. From dataset we have chosen 10 attributes values. Each attribute node has taken parameters such temperature for analysis. The simulation is done in MATLAB 2007b and Visovery Somine5 (trail version) for analysis of attribute data. The experimental result shows clustering of nodes into 4 clusters (c1, c2, c3 and c4).

Self organizing feature map clustered the input data in different clusters represented in different colors. There are different color classifications and having different meanings for that we have given brief description about the clusters formed in experimental results there exists four different clustering schemes which are designed as follows.

Flat clusters: clusters are displayed in a uniform color and without contours. This is the default visualization and is useful when neighboring clusters have similar colors, making it otherwise difficult to identify different clusters.

Shaded clusters: clusters are displayed in different colors: nodes close to the center of the cluster are indicated in a light color, nodes that are further away from the center indicated in darker colors. The term center refers to the center of the node weights in data space, not the map display space.

Global shading: individual clusters are not indicated, and the distance of the nodes from the centre of the map is indicated. Nodes in the centre (in the data space, not map display space!) are indicated in red; increasing distance from the centre is indicated in yellow, green, cyan, and blue.

U-Matrix: node shade indicates the average distance to its neighbours. Far-away nodes are indicated in a dark colour. Nodes belonging to a "dense" region of the map are indicated in a light colour.

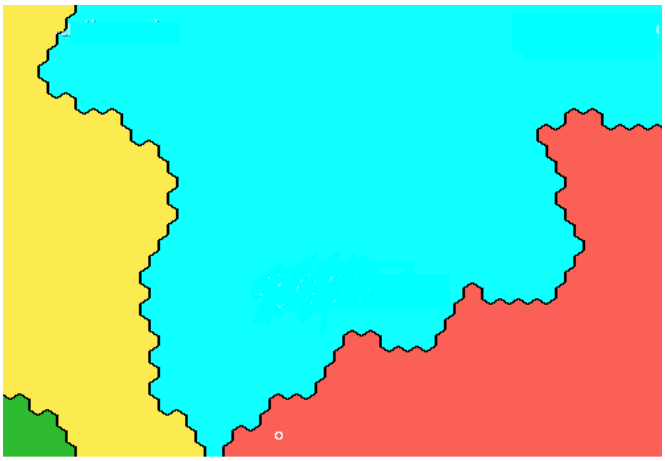


Figure 6 a. Four Flat Clusters (c1(Blue), c2(Red) c3(Yellow), c4(Green)) for Temperature Parameter

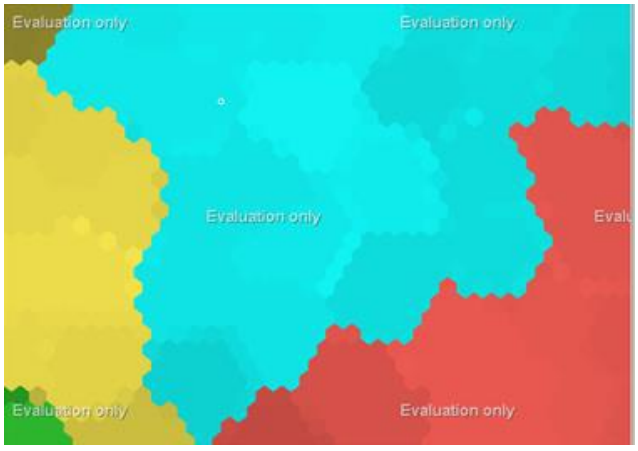


Figure 6 b. Four Shaded Clusters (c1(Blue), c2(Red) c3(Yellow), c4(Green)) for Temperature Parameter

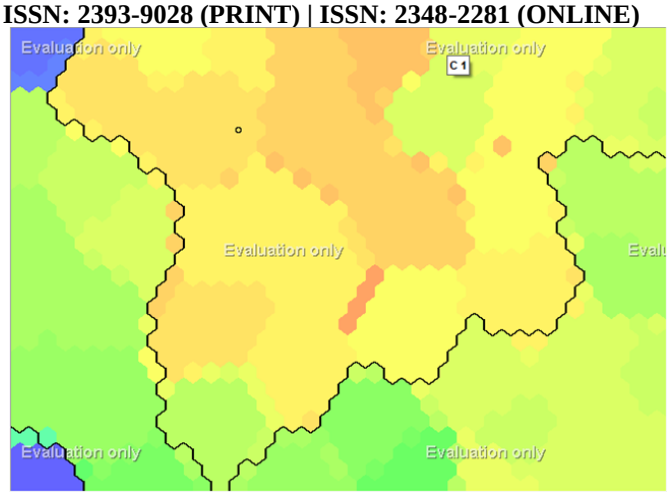


Figure 6 c. Four Global Shading Clusters for Temperature Parameter

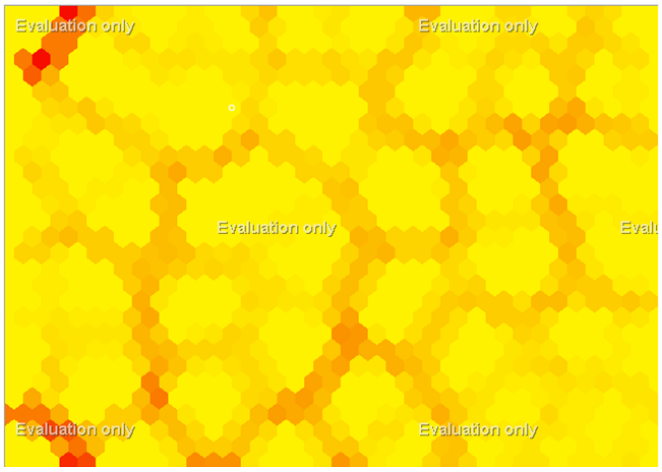


Figure 6 d. Four U Matrix Clusters for Temperature Parameter

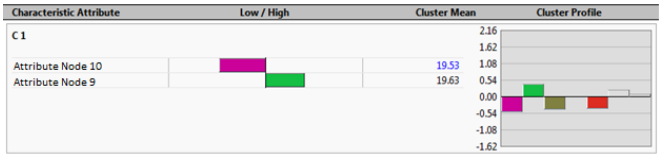


Figure. 5 a. Cluster 1 (c1) consists 2 Attributes Nodes (Attributes 10, Attributes 9) for Temperature Parameter

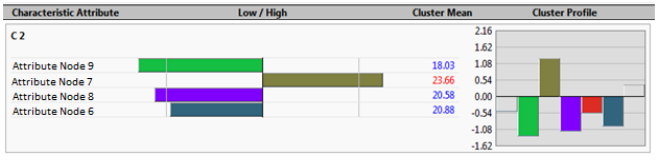


Figure. 5 b. Cluster 2 (c2) consists 4 Attributes Nodes (Attributes 9, Attributes 7, Attributes 8, Attributes 6) for Temperature Parameter

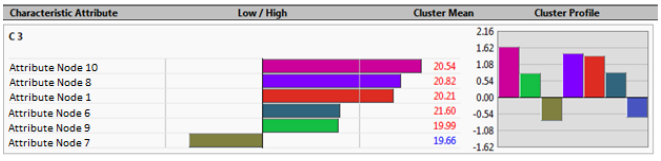
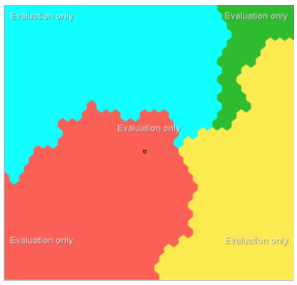
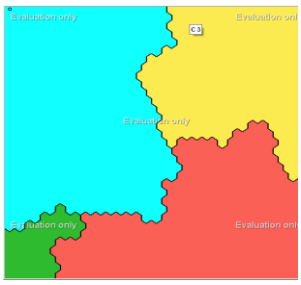


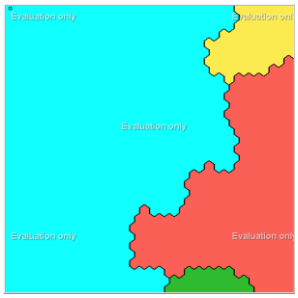
Figure.5 c. Cluster 3 (c3) consists 6 Attributes Nodes (Attributes 10, Attributes 8, Attributes 1, Attributes 6, Attributes 9, Attributes 7) for Temperature Parameter



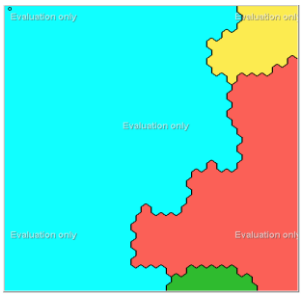
Results for 5 Attributes nodes



Results for 10 Attributes nodes



Results for 50 Attributes nodes



Results for 100 Attributes nodes

VII. SIMULATION PARAMETER

7.1 Energy Efficiency

This metric is characterized as the energy in use by the information packets to achieve the destination source. Time can be computed by separating the aggregate ever contrasts between the sending and receiving of packets.

In this research paper is based on the performance of the mobile ad hoc scenario which using routing protocols. According to this result may show and get effective evaluate mannerly.

We have implemented in MATLAB. According to ad hoc network scenario. We have implemented different mobile nodes using the routing protocol. Each routing protocol node gets the calculated energy values.

Table 1: Simulation Parameters

Parameter	Value
Channel	Wireless
Number of nodes	100
Routing Protocols	AODV-SOM, AODV, DSR, DSDV
Initial Energy	100 Joules
Mobility	0-5 m/s
Network area	1000 * 1000 sq. units

As we can see we have calculated values of energy efficiency using routing protocols. As we evaluated DSDV, DSR, AODV, ADOV-SOM scenario and AODV-SOM got the better performance which improves the performance of the network.

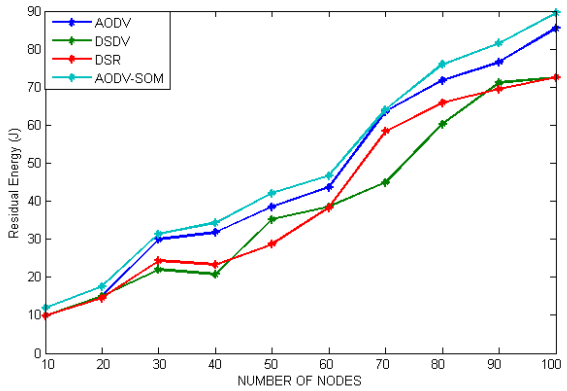


Figure : Energy Efficiency Comparison between Various Routing Protocols

In Addition, energy efficeny is another metric to overall get the performance of the network. In this we also analysed the energy effiency metric and get the realible results.

VI. CONCLUSION AND FUTURE SCOPE

In conclusion mobile ad hoc network which is used soft computing approach with the help of different routing protocol. It improves the performance of the network. In quality of service concern we have implemented energy efficiency scenario which is improves energy in the network. Therefore it enhanced the performance of the network. In this research paper we tried to efficiency energy metric to figure out the existed work done in ad hoc network. As we discuss in this paper QOS metrics which are bandwidth, delay, Jitter, Energy, Packet Loss, Link expiration and more. But it depends upon the approaches which we really want to use i.e. we use neural, genetic, fuzzy based environment or hybrid approaches [25]. According to these approaches we can try to get the good result and better way quality of services. According to these studies future work also is applied on these approaches which enhance the better quality of service using these techniques.

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