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Enhanced Multi Radio Protocol (EMRP) for efficient routing in MANETs

[1]Janhavi V, [2]Rajendra A B
[1,2]*Vidyavardhaka College of Engineering, Mysuru, India*
janhavivishwa@gmail.com

Abstract

Mobile Adhoc Networks commonly called as MANETs is a dynamic network of wirelessly connected mobile devices. Each devices in a MANET moves freely in any direction, and thus changing its links frequently to other devices. Each act as a router, as they forward the traffic unrelated to its use. Primary challenges faced in building a MANET is to properly route traffic, providing each device to repeatedly maintain the information required. Such networks do gets connected to larger internet or may operate by themselves. They may contain multiple transceivers between nodes resulting in highly dynamic, autonomous topology. MANETs in order to extend the network lifetime require an efficient dynamic routing protocol with respect to energy. In this paper we propose enhanced multi-radio protocol an improvised version of multi-radio protocol to obtain better results compared to the existing system. Result analysis is done using OMNET++. Simulation results indicate that our developed protocol is better than the existing multi-radio protocol.

Keywords- *MANETs, multi-radio protocol, OMNET++, routing protocol, energy.*

I. INTRODUCTION

Mobile Adhoc Networks is made up of several mobile wireless nodes which form an independent network without any central administrative device to forward the packets in a multi-hop manner [1]. The nodes are configured dynamically to form network connectivity [2]. They do not possess physical infrastructure and run on their battery power which shows that the energy is limited [3]. In mobile adhoc networks energy is the main criteria on which the lifetime depends many research works have been carried out to conserve energy. Such as replacing and servicing batteries may not be suitable for some power aware communications, some applications and computing has received substantial attention for spreading network lifetime [4]. MANETs are easily deployable and are used in disaster relief, military operations, mesh networks, sensor networks, VANETs. Reactive and Proactive are the two main routing protocols implemented in MANETs. In reactive packet routing the path selection is done by on-demand manner which saves energy and bandwidth which is ideal as they consume less battery power. Latency is the major drawback in reactive routing. Examples are Dynamic source routing (DSR), Ad-hoc on-demand distance vector (AODV) and Temporary Ordered Routing Algorithm (TORA). Proactive routing uses routing tables where the information of each node is stored along with transmission range. In this routing is faster but consumes more energy and bandwidth. Examples are optimal link state routing (OLSR), fisheye state routing (FSR), and Destination sequenced distance vector (DSDV). To obtain better results proactive and reactive are combined to form Hybrid protocol. Example is Zone routing protocol (ZRP). It uses proactive approach for nearby nodes and for nodes which are far away uses reactive approach [5]. Power-efficient topology control method gives reasonable transmission power to all the nodes to have moderate connectivity in the networks. Thus minimizing the overall energy depletion for per-packet transmission [6]. To minimize the energy consumption rate during active communication load distribution approach and transmission power approach is used.

Multi-radio is one such protocol which focuses on increasing the network lifetime and to conserve energy so that the packets reach the destination without any loss of information. This protocol is enhanced by data rate by reducing the energy utilization in the network. Thus improving the system performance routing the packets with shortest path, improved network lifetime and conservation of energy. In our

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paper, we propose a more efficient version of multi-radio protocol, named Enhanced Multi-Radio (EMR) protocol, to deal with ad-hoc routing and make the system more accurate in determining shortest path of routing.

The paper is structured as follows, the Section II gives literature work along with the drawbacks of the existing methods are identified. In Section III the design and implementation of novel enhanced multi-radio protocol is shown. The results are given in Section IV and the conclusion is given in section V.

II. LITERATURE SURVEY

In this section the research work carried out by different authors on MANETs to solve problems and their future work. We find that many research works is carried out on improvising the routing algorithm of packets. MANETs are broadly categorized into three categories namely: 1) Proactive 2) Reactive and 3) Hybrid.

Sun Qiang et.al [1] proposed energy-constrained characteristics in Adhoc networks by considering various QoS requirements of routing to increase the network lifetime QoS routing algorithm.
S.Rout et.al [2] proposed the different types routing techniques and the method to improve the energy efficiency and routing techniques of packet.

Xiaojun Xu et.al [3] proposed the Load balancing protocol for Mobile Adhoc networks to improve the consumption of power-efficient and network topology.
S. K. Sarkar et.al [4] proposed multi hop network MANETs with dense traffic environment and conducted performance analysis on static, dynamic, multi hop, varying traffic and scalable networks.

Chrispen Mafirabadza et. al [5] proposed EPAAODV which was the enhanced version of AODV protocol which saves more energy, better packet delivery ratio, has less number of dead nodes and better throughput.

Ashok Kumar Turuk et.al [6] put forward a two-phase DBSS protocol that deals with topology control and gives a technique to reduce overall energy utilization in the network. It discusses importance of topology and its role.

Abhijit Das et.al [7] proposed a secured scheme for topology threats in MANET which protects the network by identifying and reacting to malicious activities of node.

Ahmed Safwat et.al [8] proposed a comprehensive analysis study of power-aware routing techniques in wireless ad hoc networks and a framework to maintain the system lifetime.

The major pitfall of the existing system is the shortest path is determined based on the minimum cost between the pair of source and destination. The energy parameter is one the anticipated constrained for the optimal data transfer in the mobile adhoc networks. This motivation makes to build an energy aware minimum cost routing between the source and destination. The next section describes the proposed routing protocol.

III. METHODOLOGY

Enhanced Multi Radio Protocol is an extended protocol for Multi Radio Access Protocol. Here the main motivation is to reduce the energy consumption and also to reduce the delay and provide the optimal output. The EMRP Mechanism is modeled into three modules namely minimum cost path, minimum energy path and residual energy path. In this paper the first two modules are simulated. The detailed descriptions of the algorithm with its corresponding flowcharts are explained.

A. Minimum cost/path

Notations: N indicates number of nodes.
S is a sender node
D is a destination node

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1 Start
2 Deployment of N
3 Select S and D where (S,D) € N
4 Compute optimal and back up path between S and D
5 Send data between S and D
6 Stop

The minimum cost path describes the path where the amount of cost between the sender and destination is minimum. After calculating the various choices paths between the sender and the destinations. The least cost and secondary least cost are identified and send the path to the sender to follow the path as depicted in the flowchart Figure 3.1. This path is not solely decided, even after traversing the energy path then the final path will be decided as depicted in Figure 3.2.

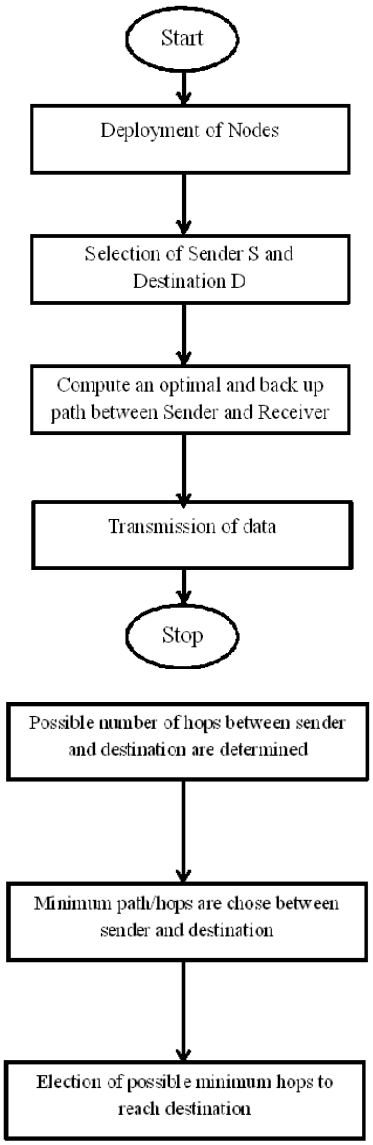

Figure 3.1 Enhanced Multi Radio Protocol

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Notations

N indicates number of nodes.
S is a sender node
D is a destination node

1. Select possible hops between S and D where (S,D) € N
2. Select minimum hops between S and D
3. Election of minimum hops to reach D.

B. Maximum energy path

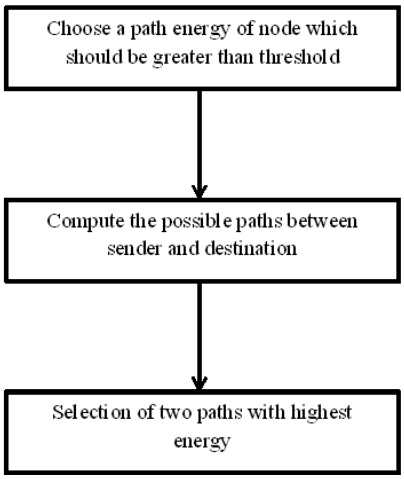

Figure 3.2 Enhanced Multi Radio Protocol

Notations

N indicates number of nodes.
S is a sender node
D is a destination node
α is a threshold value

1. Select path energy from N where energy > α
2. Compute possible path between S and D, where (S,D) € N
3. Select multiple paths where energy > α

IV. RESULTS AND ANALYSIS

The following section gives the results that are simulated using an open source network simulator tool Omnet++. The Omnet++ is an open source event driven simulator. The network is done using 50 nodes by varying impairments such as bandwidth, delay, queue limit based on the Simulation Topology as shown in the Figure 4.1

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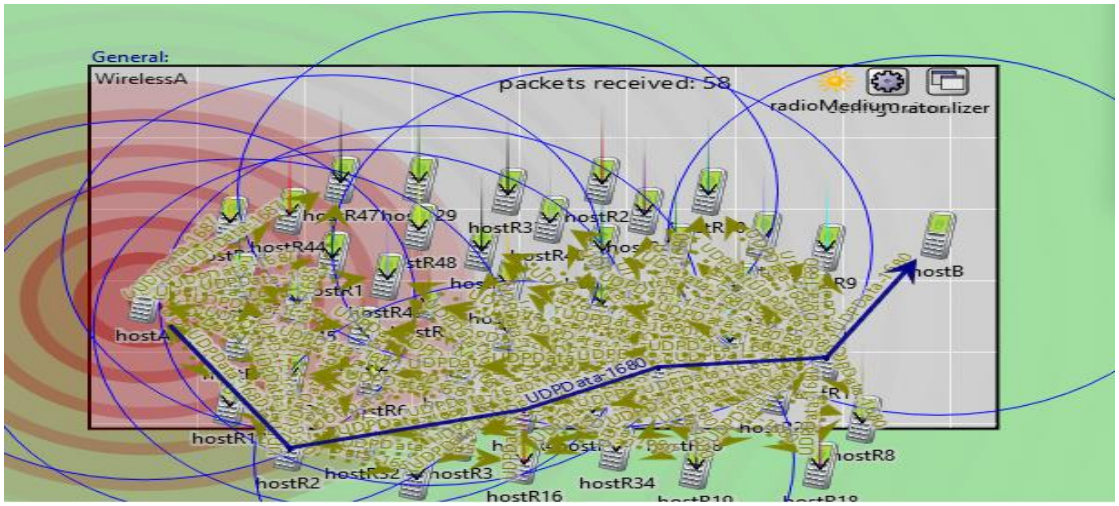

Figure 4.1 Simulation Setup

The various QoS parameters like Throughput, End-to-End Delay, and Power Consumption are considered for the simulation. The Power Consumption is considering with three modes of operations Radio mode, Transmission Mode is represented in Figure 4.2 and Residual energy mode is represented in Figure 4.3.

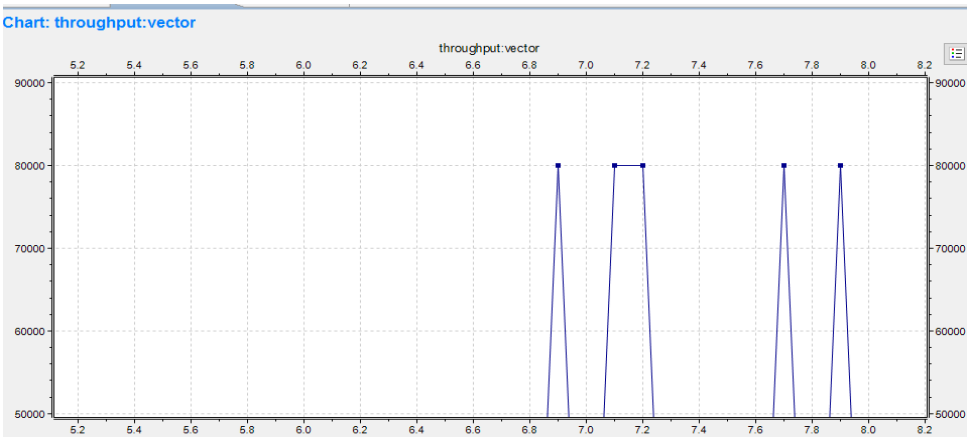

Figure 4.2 Throughput

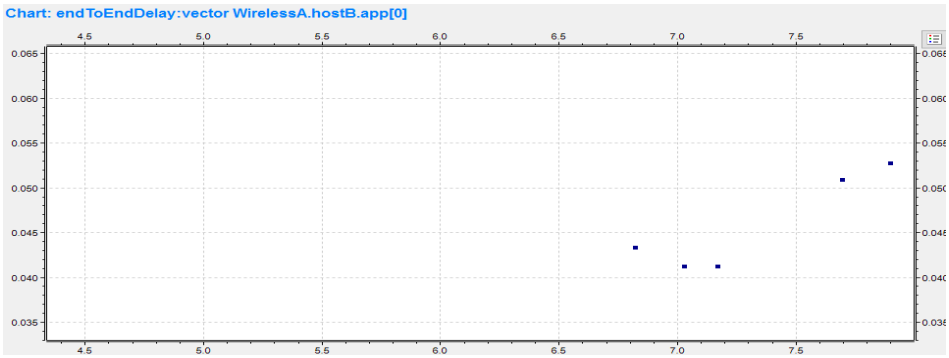

Figure 4.3 End to End Delay

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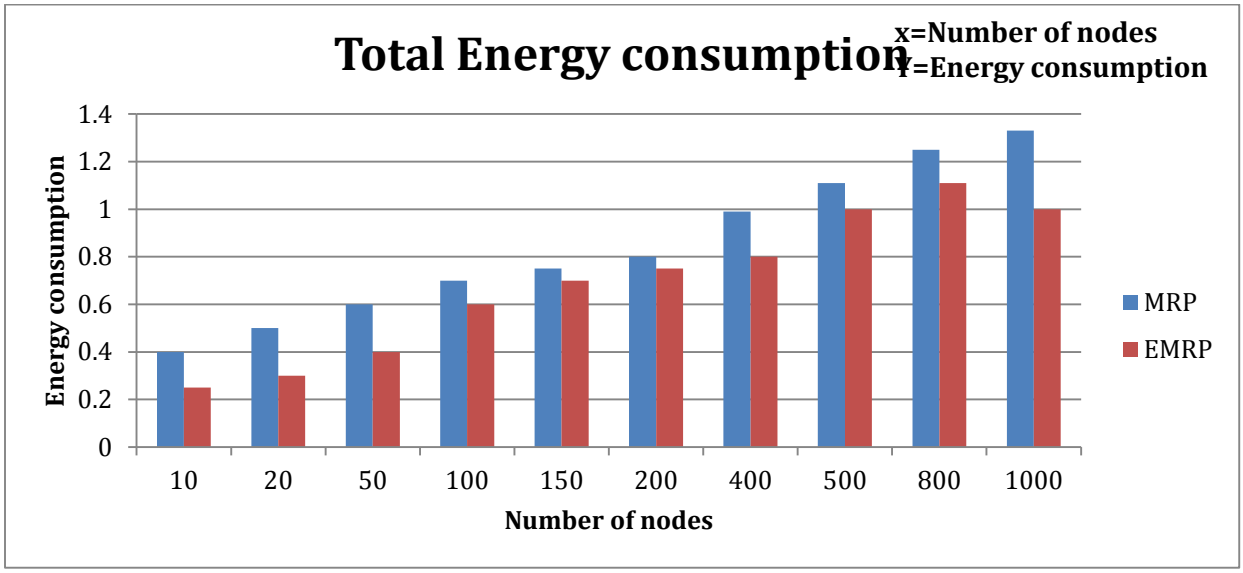

Figure 4.5 Energy utilization graph for 1000 nodes by considering x axis as total number of nodes and y axis as rate of energy consumed.

Total energy consumption of MRP and EMRP regarding number of nodes is shown in figure 4.5. For increase in number of nodes, it requires more energy to transmit the data. It shows that EMRP utilizes less energy compared to MRP, since it offers high speed transmission of data.

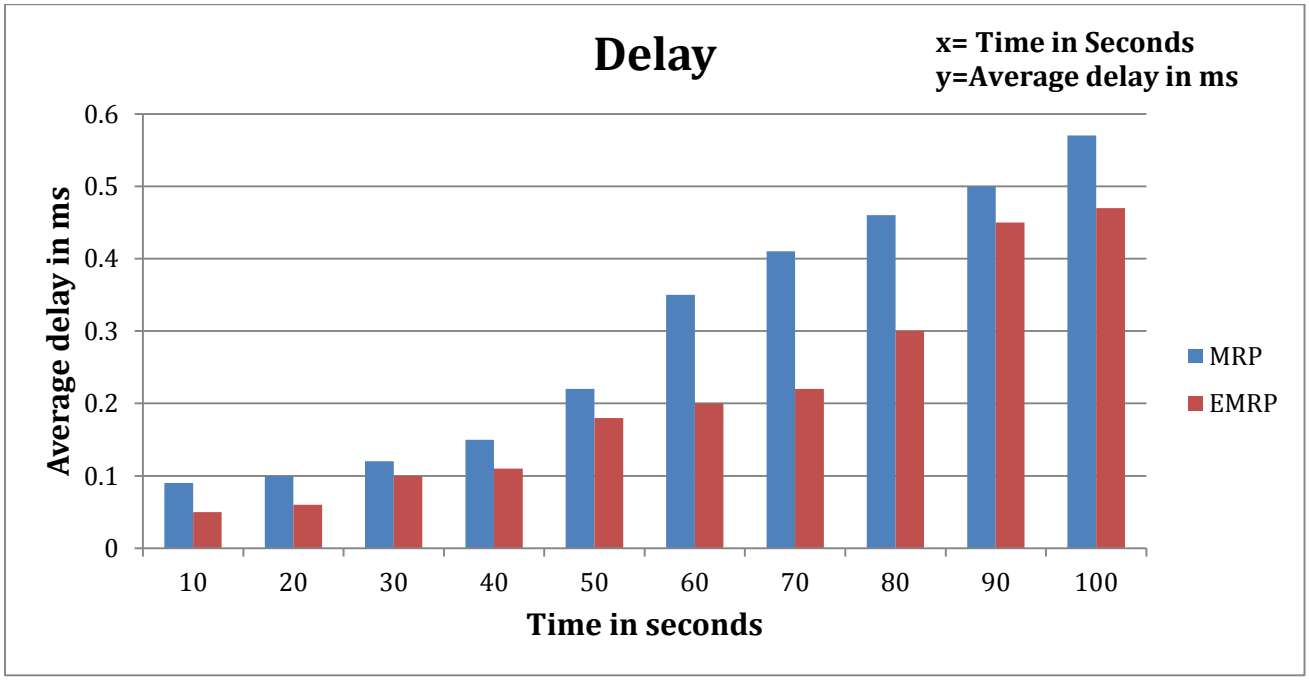

Figure 4.6 Average delay of MRP and EMRP where x is time and y is the average delay

Figure 4.6 illustrate the average delay of between MRP and EMRP. The latency of MRP increases than EMRP. EMRP reduces the latency because its higher signal strength and higher battery life.

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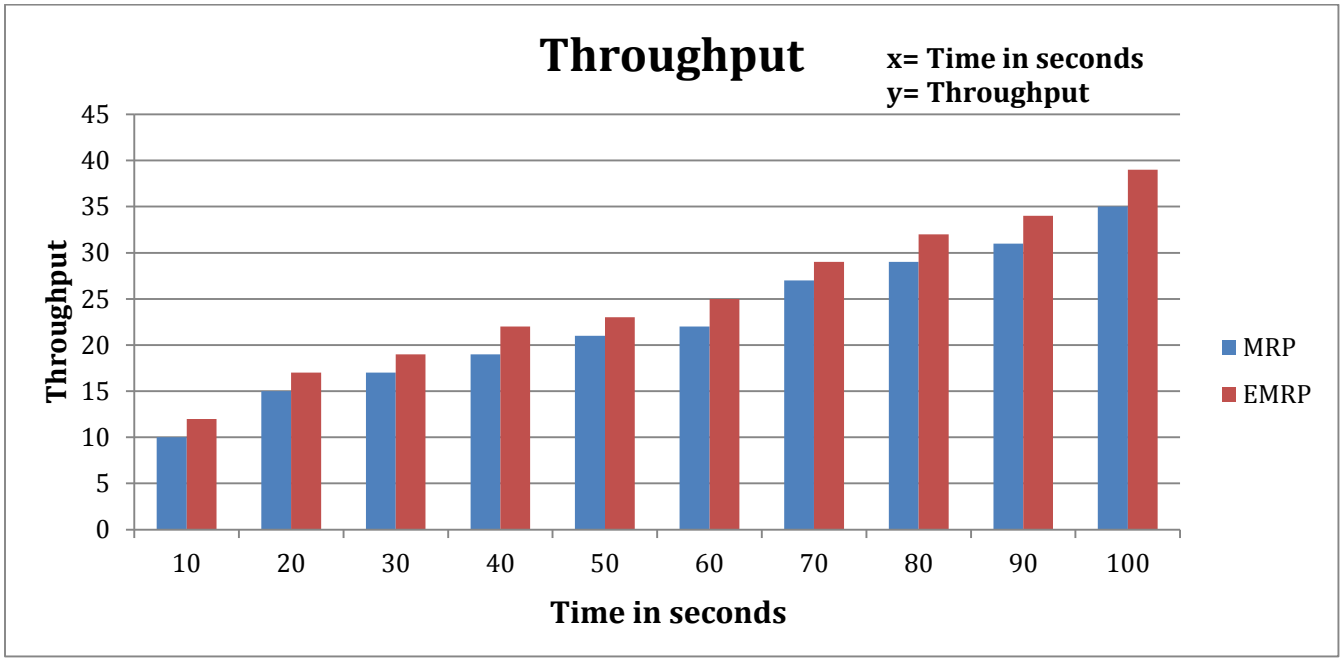

Figure: 4.7 Throughput of MRP and EMRP where x shows time and y shows throughput

The throughput of EMRP increases as the signal strength increases. Figure 4.7 shows that EMRP outperforms than MRP in terms of throughput.

V. CONCLUSION

As proposed in our paper the enhanced multi-radio protocol provides an efficient approach compared to the existing protocol by the results obtained. The proposed protocol saves energy, and also determines the shortest path to route the packets with limited time. To determine the results used OMNET++ tool to test the cases and the results obtained are shown. It can be concluded that the proposed protocol is more efficient and its performance from the results substantiate the statement.

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