Energy Efficient Multi Path Routing Protocol for Mobile Ad-Hoc Network Using the Fitness Function

[1]Vyshali V R, [2]Mrs. Pushpalatha S
[1]PG Student , [2]Assistant Professor
[1]Department of Digital Electronics and Communication system
[1]VTU PG Centre, Mysuru, Karnataka, India.

ABSTRACT : Mobile ad hoc network (MANET) is a collection of wireless mobile nodes that dynamically form a temporary network without the reliance of any infrastructure or central administration. Energy consumption is considered as one of the major limitations in MANET, Energy consumption is the factor to improve network lifetime and various energy efficient algorithm has been developed in previous to reduce energy absorption. This paper highlights the energy consumption in MANET by applying the fitness function technique to optimize the energy consumption in ad hoc on demand multipath distance vector (AOMDV) routing protocol. The proposed protocol is called AOMDV with the fitness function (FF-AOMDV). The fitness function is used to find the optimal path from source node to destination node to reduce the energy consumption in multipath routing. The performance of the proposed FF-AOMDV protocol has been evaluated by using network simulator version2 (NS2). The experimental results clearly demonstrate that the proposed algorithm reduces the average energy consumption when compared to the standard AOMDV routing protocol.

INDEX TERMS: Energy efficient protocol, mobile ad hoc network, multi path routing, fitness function, routing protocol.

I. INTRODUCTION:

Ad hoc networks are crucial in the evolution of wireless networks, as they are composed of mobile nodes which communicate over wireless links without central control. The traditional wireless and mobile communication problems like bandwidth optimization, transmission quality enhancement and power control are directly inherited by ad-hoc wireless networks .Furthermore, new research problems like Configuration advertising, discovery and maintenance are also brought on by ad hoc networks because of their multi-hop nature, lack of a fixed infrastructure and ad hoc addressing and self-routing.

MANET are more efficient than cellular networks. The cellular networks are infrastructure network or radio network made up of radio cells each served by a fixed transmitter known as base station. Ad Hoc Network is a fully distributed system, no need of any central entity, self-organizing, self-healing network. In cellular networks they maintain static connectivity but take large time to setup the connections. They are fixed, pre located cell sites and base stations. The network topology is stable in nature.

This paper presents an energy efficient multipath routing protocol called ad-hoc on demand multipath distance victor with the fitness function (FF-AOMDV). The FF-AOMDV uses the fitness function as an optimization method, in this optimization, we seek for two parameters in order to select the optimum route on of them is energy level of the route and the another one is the route distance in order to transfer the data to the destination more efficiently by consuming less energy and prolonging the network lifetime.

The rest of the paper is organized as follows: Section 2 discusses the background and related works, Section 3 presents methodology; Section 4 presents the proposed FF-AOMDV; Section 5 presents the results and evaluation, Section 6 concludes the study .

II. BACKGROUND & RELATED WORK:

Many research papers have been studied based on performance evaluation, optimization, sizing techniques, efficiency improvement, and factors affecting system performance, economical and environmental aspects of Energy Efficient Multipath Routing Protocol for Mobile ad hoc Network using different topologies.

An on-demand routing protocol, AOMDV has its roots in the ad hoc on-demand distance vector (AODV), a popular single-path routing protocol. AOMDV creates a more extensive AODV by discovering, at every route discovery process, a multipath (i.e. several other paths) between the source and the destination. The multipath has a guarantee for being loop-free and link-disjoint. AOMDV like wise offers two key services: route discovery and route maintenance. Since it greatly depends on the AODV route information, which is already available, AOMDV incurs less overhead than AODV through the discovery of multiple routes. Compared to AODV, AOMDV's only additional overhead is extra route requests (RREPs) and route errors (RERRs) intended for multipath discovery and maintenance, along with several extra fields to route control packets (i.e. RREQs , RERRs and route replies (RREPs)) [1].

Chen et al. [4] analyzed two factors that influence the transmission bandwidth: the signal strength of the received packets and the contentions in the contention-based MAC layer. These two factors may cause more power to be consumed during data transmission. They proposed a power aware routing protocol called minimum transmission power consumption routing protocol (MTPCR). It discovers the desired routing path with reduced power consumption during data transmissions. MTPCR analyses the power consumption during data transmission with the help of the neighboring nodes and using a path maintenance mechanism to maintain optimal path bandwidth. This mechanism helps to reduce the power consumption more efficiently during data transmission along with the number of path breakages. Min max battery cost routing (MMBCR)

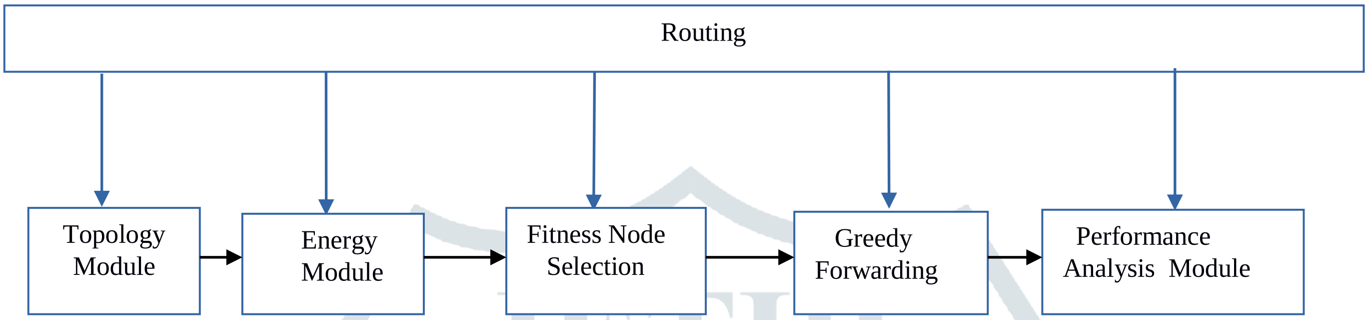
Sharma et al. [7] proposed an energy efficient reactive routing protocol that uses the received signal strength (RSS) and power status (PS) of mobile nodes. The proposed link failure prediction (LFP) algorithm used the link-layer feedback system to update active routes. Comparing the results of the proposed algorithm with existing algorithms, in terms of energy consumption, link failure probability, and retransmission of packets, the proposed algorithm outperform the existing algorithms.

Rajaram and Sugesh [8] addressed the issues of energy consumption and path distance from the source to the destination in MANET. They proposed a multipath routing protocol based on AOMDV called as, power aware ad-hoc on demand multipath distance vector (PAAOMDV). The proposed protocol updates the routing table with the corresponding energy of the mobile nodes. As this was a multipath protocol, it shifts the route without further overhead, delay and loss of packets. The simulation results showed that PAAOMDV performs well compared to AOMDV routing protocol after introducing energy-related fields in PAAOMDV.

Sun et al.[11] propsed an Energy-entropy energy-entropy multipath routing optimization algorithm in MANET based on GA (EMRGA). The key idea of the protocol was to find the minimal node residual energy of each route in the process of selecting a path by descending node residual energy. It can balance individual nodes battery power utilization and hence prolong the entire networks lifetime and energy variance. Experimental results show that the algorithm is efficient and has a promising performance advantage for multipath traffic engineering and evaluates the route stability in dynamic mobile networks.

III. METHODOLOGY

The project is divided into five main modules as shown below.



IV. THE PROPOSED FF-AOMDV

In this paper, we proposed a new multipath routing protocol called the FF-AOMDV routing protocol, which is a combination of Fitness Function and the AOMDV's protocol. In a normal scenario, when a RREQ is broadcasted by a source node, more than one route to the destination will be found and the data packets will be forwarded through these routes without knowing the routes' quality. By implementing the proposed algorithm on the same scenario, the route selection will be totally different. When a RREQ is broadcast and received, the source node will have three (3) types of information in order to find the shortest and optimized route path with minimized energy consumption. This information include:

- Information about network's each node's energy level
- The distance of every route
- The energy consumed in the process of route discovery.

The route, which consumes less energy, could possibly be (a) the route that has the shortest distance; (b) the route with the highest level of energy, or (c) both. The source node will then sends the data packets via the route with highest energy level, after which it will calculate its energy consumption.

FF-AOMDV implements the same techniques after selecting the route with the highest energy level, the routing table keeps information about the route with the least distance. Simulations are conducted to run the FF-AOMDV protocol. In this simulation, an OTcl script has been written to define the network parameters and topology, such as traffic source, number of nodes, queue size, node speed, routing protocols used and many other parameters. Two files are produced when running the simulation: trace file for processing and a network animator (NAM) to visualize the simulation. NAM is a graphical simulation display tool. figure1 shows the route selection of FF-AOMDV based on specific parameters.

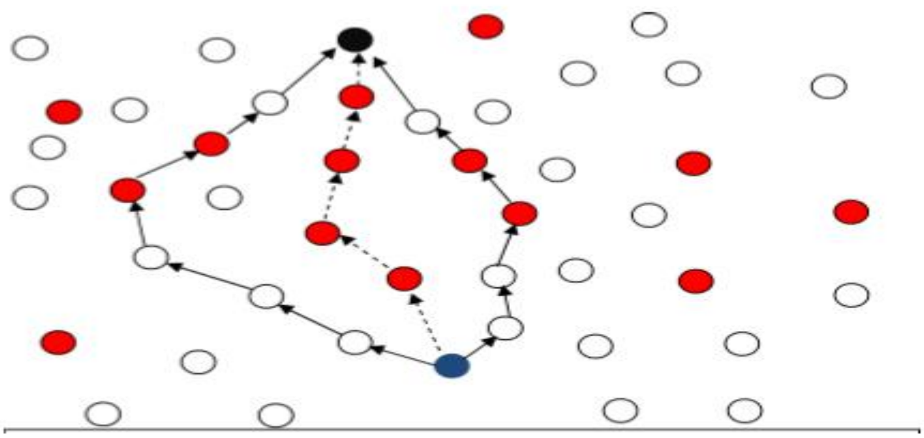


Figure 1: Route selection in FF-AOMDV

The FF-AOMDV initially broadcasts a RREQ in order to gather information regarding the available routes towards the destination as shown in figure1 where the fitness function performs a scan on the network in order to locate nodes that have a higher level of energy (red nodes). The source point will then receive a RREP that contains information on the available routes towards the destination along with their energy levels. Calculating each route's energy level, the fitness function will then compare to finding the route with highest energy level. The optimum route refers to the route that has the highest energy level and the less distance. Priority is given to the energy level, as seen on the route with the discontinuous arrow (Figure1). In another scenario, if the route has the highest energy level, but does not have the shortest distance, it can also be chosen but with less priority. In some other scenarios, if the intermediate nodes located between the source and destination with lesser energy levels compared to other nodes in the network, the fitness function will choose the route based on the shortest distance available.

V. RESULTS & EVALUATIONS

In simulation by using NS2 simulator and utilized the Constant Bit Rate (CBR) as a traffic source with 50 mobile nodes that are distributed randomly in a 1200 m* 1100 m network area; the network topology may therefore, undergo random change since the nodes' distribution and their movement are random. The transmission range of the nodes was set to 200 m, while, for each node, the initial energy level was set to 100 joules. After deployment of network architecture find optimum path using FF-AOMDV According to different parameter, Table presents all the simulation parameters.

Parameters	values	units
Number of nodes	0-49	Node
Queue size	50	Packet
Simulations area	1200*1100	$meter^2$
Routing protocol	FF-AOMDV	
Traffic type	CBR	
Initial energy	100	Joules
Transmission power	10.0	Joules
Receiver power	1.0	Joules
Sleep power	0.1	Joules
Idle power	0.005	Joules
Antenna used	Omni directional antenna	
Transition power	0.2	Joules
Transition time	0.005	Seconds
Simulation time	10, 20, 30	Seconds

TABLE: Simulation parameters.

VI. EXPERIMENTAL RESULTS

A. PACKET DELIVERY RATIO: It means the ratio of the data packets that were delivered to the destination node to the data packets that were generated by the source. This metric shows a routing protocol's quality in its delivery of data packets from source to destination. The higher the ratio, the better the performance of the routing protocol. The figure 2 shows the variation of packet delivery ratio on varying simulation time for FF-AOMDV compare to existing one.

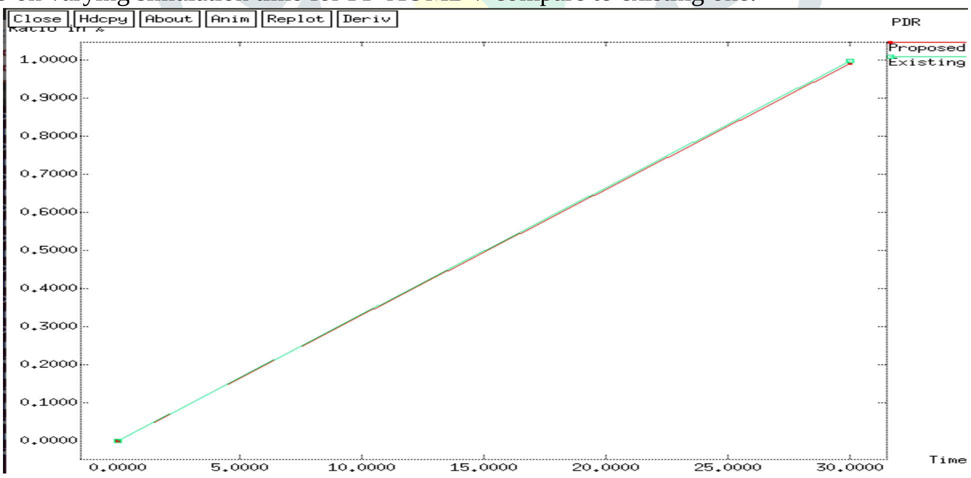


Figure 2: Graph for Packet delivery ratio

B. THROUGHPUT: Throughput is known as the number of bits that the destination has successfully received. Expressed in kilobits per second (Kbps). Throughput measures a routing protocol's efficiency in receiving data packets by destination. Throughput is calculated as follows:

TP=(number of bytes received *8/ simulation time)*1000kbps

Figure 3 shows the comparison of throughput behalf of simulation time. In this figure x axis show the simulation time and y axis show the throughput. In this fig. shows the effect on the throughput on varying simulation time for FF-AOMDV compare with existing system.

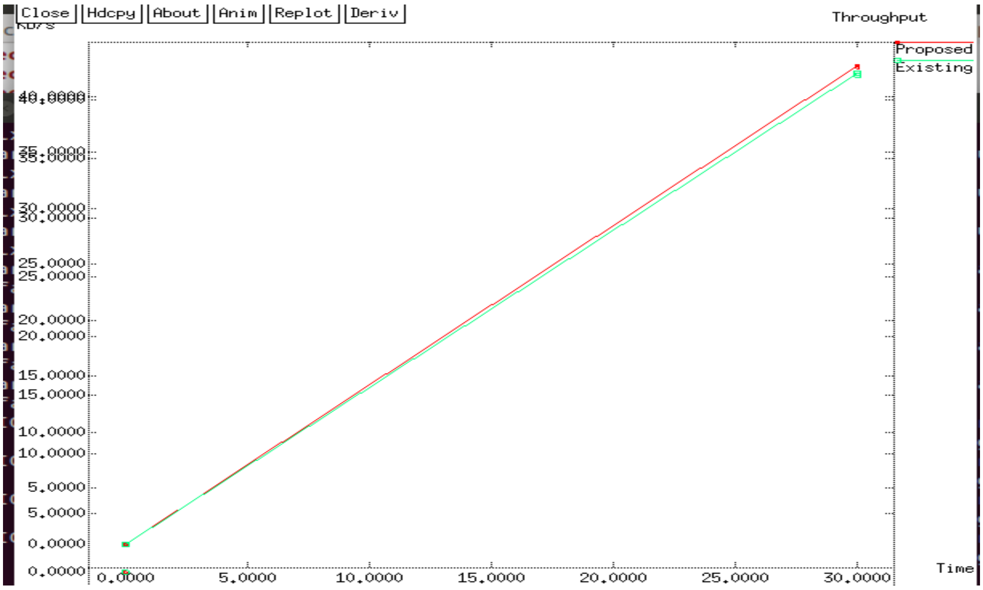


Figure 3: Graph of Throughput

C. END-TO-END DELAY: End-to-End delay refers to the average time taken by data packets in successfully transmitting messages across the network from source to destination. This includes all types of delays, like queuing at interface queue; propagation and transfer times; MAC retransmission delays; and buffering during the route discovery latency. The figure 4 shows the change of end-to-end delay for FF-AOMDV and it will provide better results compare to the existing.

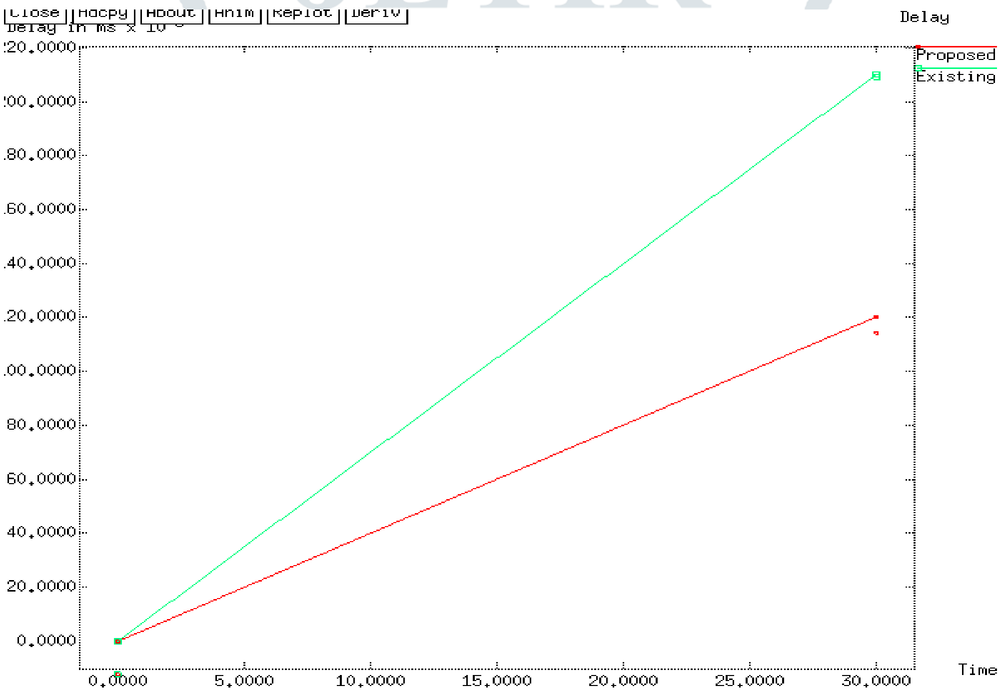


Figure 4 : Graph for ene-to-end delay

D. ROUTING OVERHEAD RATIO: The routing overhead ratio metric is the total number of routing packets, which is divided by the overall number of data packets that were delivered. This study analysed the average number of routing packets that is required to deliver a single data packet. This metric offers an idea about the extra bandwidth that is consumed by the overhead in order to deliver data traffic. The routing overhead has an effect on the network's robustness in terms of the bandwidth utilization and battery power consumption of the nodes. Figure 5 shows the variation of routing overhead ratio.

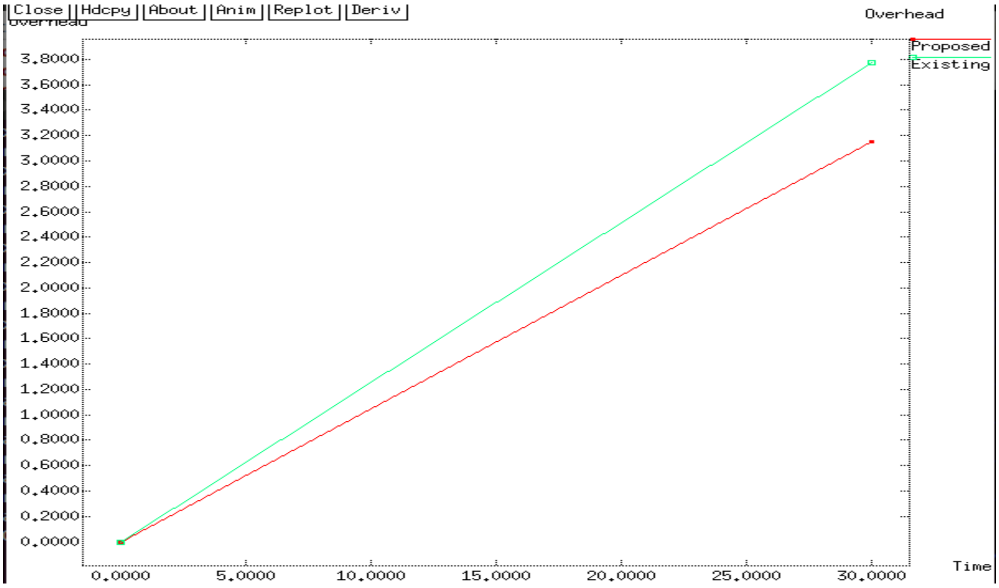


Figure 5 : Graph for Routing overhead ratio

E. ENERGY CONSUMPTION: Energy consumption refers to the amount of energy that is spent by the network nodes within the simulation time. This is obtained by calculating each node's energy level at the end of the simulation, factoring in the initial energy of each one. The following formula will produce the value for energy consumption. Figure 6 shows the variation of energy consumption .

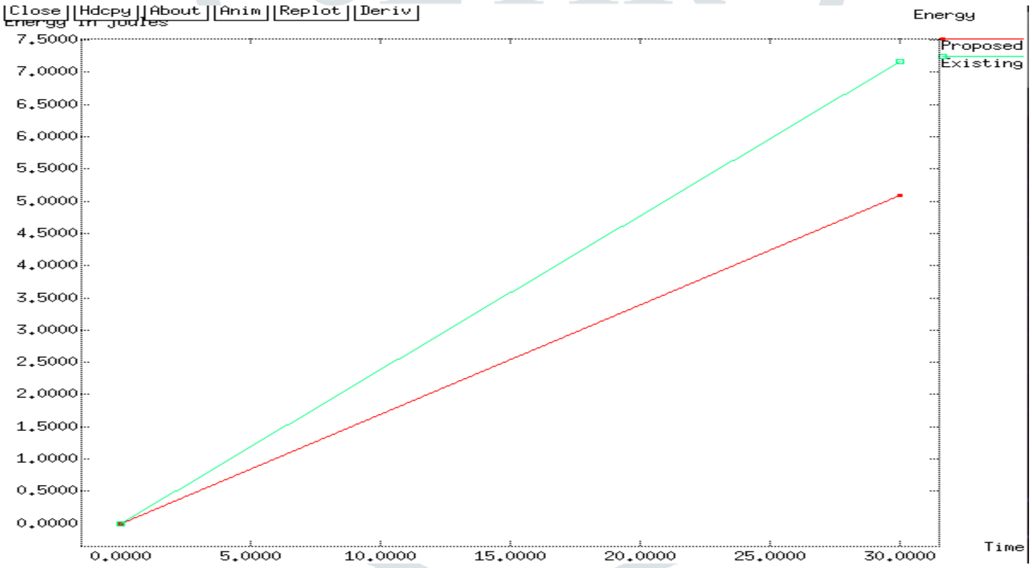


Figure 6 : Graph for energy consumption

VII. CONCLUSION & FUTURE WORK: In this research, we proposed a new energy efficient multipath routing algorithm called FF-AOMDV simulated using NS-2. These scenarios were tested by five (5) performance metrics (Packet delivery ratio, Throughput, End-to-end-delay, Energy consumption and Network lifetime). Simulation results showed that the proposed FF-AOMDV algorithm has performed much better than existing one in throughput, packet delivery ratio and end-to-end delay. It also performed well against AOMDV for conserving more energy and better network lifetime.

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