Power aware routing for MANET using PSO

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Abstract: ***In mobile ad hoc network during path discovery nodes having high battery power needs to be involved to avoid link failure and delay. In case of multimedia communication through mobile Ad-hoc network various metrics such as battery power, total delay, Bandwidth influence the performance. To enhance the real time communication performance, it is essential to optimize the metrics parameters. In traditional AODV protocol the data packet is transmittedto the neighboring node only through the shortest path and it cannot satisfy multi objective approach. In this paper particle swam optimization (PSO) approach is used to improvise the problem and find a relevant path instead of shortest path. For the fitness value calculation instead of only hop count both hop count and energy is used. The optimized PSO-AODV shows improved quality of service routing metrics to satisfy QoS constraint requirement. The result found is compared with Genetic Algorithm (GA) and Ant colony optimization (ACO) which gives shortest path with energy efficiency under varied number of node condition.***

Index Terms: ***Quality of service routing, Mobile ad hoc network, Particle Swarm Optimization, Energy proficient routing.***

I. INTRODUCTION

Static routing protocols don't work efficiently in the dynamic environment of mobile ad hoc networks (MANETs). So, the requirement of dynamic routing protocols raised. Accordingly, the requirement of quality of service (QoS) of different multimedia application up to certain point must be fulfilled by these protocols. In laptops and different hand held devices for audio video and multimedia applications providing QoS is an essential task. End-to-end delay, bandwidth, delay, battery power, hop-count, packet delivery ratio are several QoS parameters. Discovering better route which can satisfy the various requirement of QoS constraint is the key purpose. QoS metrics can be given by any one or a set of parameters.

In a MANET nodes sharing the network are driven by insufficient battery power. Battery exhaustion can initiate link failure. Effective consumption of battery energy is a vital concern. So energy saving must be considered at all protocol layers and is one of the important design strategy.

II. RELATED WORK

Several researchers have investigated different Meta-heuristic algorithms to overcome the difficulty of QoS routing. Several methodologies have been suggested and can be found in literature. V.V Mandhare[1] has proposed CSO-AODV protocol to discover the appropriate route by overcoming the problem of shortest path satisfying different QoS limitations. By combining the two different heuristic techniques CSA and DE a hybrid algorithm is presented for resolving the multi constrained (QoSR) problem by S. Rajalakshmi[2]. Nivetha [3,10] has proposed EAGHM method to get better performance keeping in view multiple constraints by using the benefits of ACO and GA. Nancharaiah et al.[4] have merged two approaches and the hybrid algorithm finds the best path with minimum cost power and end to end delay. Ant based multi objective has proposed QoS routing algorithm to reduce delay and to have efficient routing in a high mobile scenario [5,7]. A new variant of multicast routing optimization technique is used to find the low-cost routing path in a tree based approach with bandwidth and delay constraints [6].

III. PARTICLE SWARM OPTIMIZATION

Particle swarm optimization (PSO) algorithm is a population based computational technique based on the behavior nature such as bird flocking and fish schooling which was introduced by Kennedy and Eberhart [8] in 1995. In the PSO each individuals is a possible solution which is known as particles in the multidimensional search space. The particles starts with an initial position and velocity and its keep on updating itself the particle's own and neighbors experience or the experience of the whole swarm.

The particle updates their position and velocity by the following equations:

$$v_{new} = w * v_{current} + c_1 rand(\ \ )(p_{best} - x_{current}) + c_2 rand(\ \ )(g_{best} - x_{current}) \quad (1)$$

$$x_{new} = x_{current} + v_{new} \quad (2)$$

Where c_1 and c_2 are called acceleration coefficients. Parameter w is the inertia weight which helps to balance the exploration and exploitation of PSO. p_{best} and $v_{current}$ is the current position and velocity of particle. g_{best} is the global best position of the best particle among all the particles in the population.

IV. AD-HOC ON-DEMAND DISTANCE VECTOR ROUTING PROTOCOL

Different types of routing protocols are there. Amongst them AODV is reactive, demand-driven, dynamic, and efficient routing protocol. AODV protocol uses sequence number. Different phases of AODV protocol are route discovery, route maintenance and route reply. In AODV the presence of neighboring nodes can be sensed by the 'hello message'. Through the entire possible path the route request message is flooded. But the problem arises when data is

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sent from the source node through the shortest path having less number of hop counts, which produces congestion. Primarily congestion on a defined path results in high packet drop rate. Secondarily, requirement of time by the packets to reach the destination is high. High battery power is essential for this unusual processing overhead. So the QoS demand by the multimedia applications cannot be fulfilled by AODV protocol. Consequently, it is crucial to optimize different QoS measures to address the drawbacks of AODV protocol.

A. PSO_AODV

The PSO_AODV algorithm is used to find the best possible path for reliable packet delivery. If the selected nodes are lack of energy proficiency and overburdened with heavy traffic data transfer to the destination get affected.

Hence to overcome this problem one optimized solution is proposed for AODV based on PSO algorithm [9]. Here source node communicates the packet only to those nodes whose residual energy level is 20 %of battery power. Each time the information of the intermediary node is recorded in the routing table of the data packet in order to avoid the loop routing. Once the destination node is reached the transmission of the RRPLY packet begins. When the source receives RRPLY packet through multiple path it computes the fitness function for each path. Then the route with best fitness value will be selected for packet transmission.

B. Proposed System Methodology

In AODV protocol the RREQ packet is broadcasted to the neighboring nodes in route discovery phase. The intermediate node forwards it and finally it reaches at the destination. Then the RRPLY packet is sent from the destination. Through multiple paths the data traverse towards source node and the path having less number ofhopcounts is selected for delivering of data as it is the selected shortest path. Here in the proposed work some modification is done for the broadcasting of route request packet using PSO algorithm. The source node will send the packet over those links whose calculated fitness value is optimum. In place of only hop counts, route is calculated by using both residual energy and hop counts. So the nominated optimized path results in fulfilling the QoS constraint.

V. DEFINING QOS PARAMETERS

An efficiency of a path from source to destination depends on the routing metrics such as end-to-end delay, bandwidth, hop-counts, and residual battery power. A path P is selected as an optimized path when it will satisfy the maximum battery energy minimum delay and hop count. Different performance metrics considered here are:

Packet delivery ratio (PDR): It is the proportion of packets delivered to the destination to the packet generated from the source node.

End-to-end delay: It is the summation of time elapsed to transmit the data through the traversal from source to destination. Delay is sum of the delay monitored in whole route R and the delay occurred at intermediary hops of route R.

Hop-count: The intermediary node count through the traversal from the source to destination. Generally least possible Hop-counts (n) are considered.

Residual node energy: It is given as the residual battery power after a data communication. Bi is the remaining battery energy at node i. referring this value, the energy lifetime of a route (R_{ij}) among nodes i and j can be predicted.

VI. Objective Function

In this paper, residual energy and hop count are considered as constraints in the multicast routing problem to obtain the best optimal path for packet transmission from source to destination.In this paper we have considered a bi-objective function

$$F(x) = w_1 \times (F_1) + w_2 \times (F_2) \qquad (3)$$

Where, w_1, w_2 is the weight co-efficient and $F_1$is the primary objective i.e. residual energy and the F_2 is the secondary objective i.e. the Hop-counts.

VII. Simulation Result

The simulation results are examined with varied statistics of nodes. Six diverse scattered nodes, from 40 to 110, are exhibited to find the result of the algorithm. The pause time was set to 40 s. The movement of nodes is set to 15 m/s.

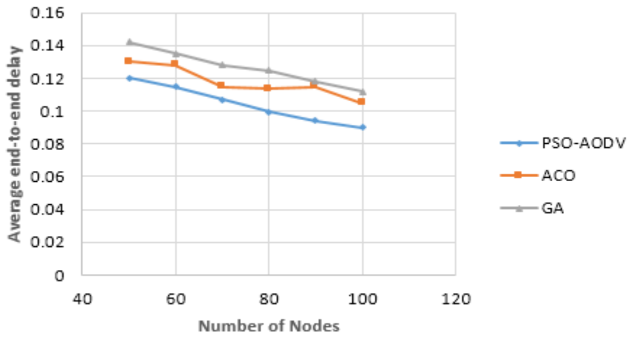

Fig. 1:comparison of No. of Nodes and end to end delay

In fig. 1 the proposed PSO_AODV algorithm has shown a better result than GA and ACO model. Here the end to end delay is measured against no. of nodes. In the above scenario when the no. of node increases, there is a constant decrease in delay as availability of neighboring node increases. When the counting of node becomes more than 110 the possibility of packet drop arises because of collision.

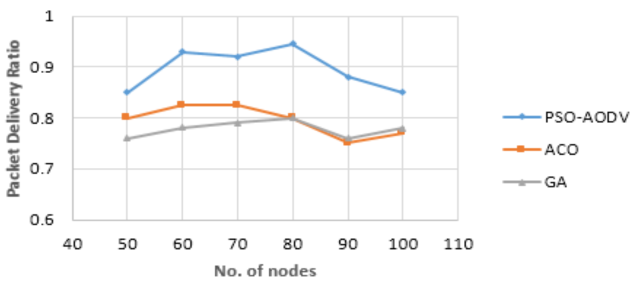

Fig. 2: Comparison of No. of nodes and PDR

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Fig 2 shows the graph of packet delivery ratio with respect to no. of nodes. Here we can see once the node count becomes 80 the maximum packet delivery is grasped, but this reduces with increasing no. of nodes.

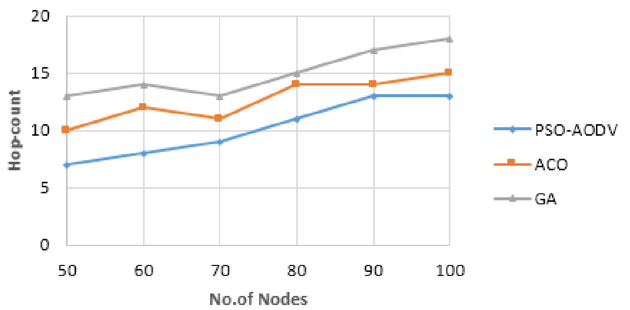

Fig. 3: Comparison of No. of nodes and Hop-Count

Fig 3 shows the calculated sum of hops used in transferring data from the source node to the destination node .From the graph it is illustrated that sum of hops explored are minimum in case of PSO_AODV.

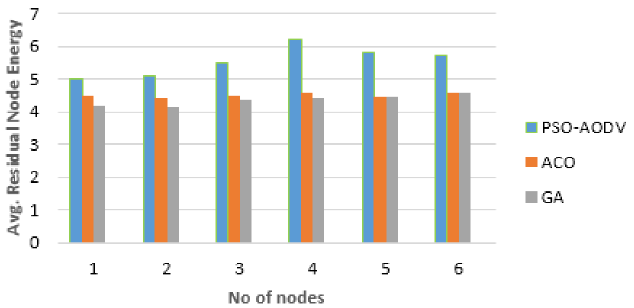

Fig. 4:Comparison of No. of nodes and Avg. residual node energy

Fig 4 illustrates residual battery power of the node after simulation. Here we have considered the nodes having minimum 20% of battery power or more than that. After the simulation the outstanding battery life of node helps for further communication without any link break.

VIII. CONCLUSION

Versatile nature of mobile ad-hoc network (MANET) always causes difficulty in quality of service routing. By the anticipated approach the performance and proficiency of the network is improved by merging the meta-heuristic approach with AODV. This is simulated under varying node condition. This work gives better outcome when compared with ACO and GA model. In future by enhancing the PSO algorithm our suggested system can be more robust.

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