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An Optimize Genetic Based Routing Protocol for QoS in MANET

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ABSTRACT

Mobile Ad hoc Networks is autonomous, multi hop network in which Quality of Service (QoS) for a network is measured in terms of the exact amount of data which a network transfers from one place to another during a certain time. QoS for Mobile Ad hoc Networks is a distinct task due to limited resource and dynamic topology environment. The link state information in the network such as bandwidth, node energy, error rate, jitter and delay should be accessible and manageable. The proposed work is to show a genetic based routing approach to optimize the routing in MANETs. The genetic approach will generate an optimized path on the basic of congestion over the network. The result path in NS2 will improve the data delivery over the network. The paper is to study about MANET, QOS and tries to develop a network on which genetic algorithm is applied to generate an optimized path.

Key words : MANET, QOS, Genetic, Delivery, Routing, Optimized

1. INTRODUCTION

A network which is a collection of self configurable mobile nodes with no fixed infrastructure is referred as the mobile ad-hoc network. MANET have a dynamic topology as the nodes are roaming in the network continuously therefore, routing is a critical and challenging task due to high node mobility.

Genetic based approach is developed by the linguistic variables namely average packet drop rate, average packet delivery ratio; average end-to-end delay and average hop count. As routing is highly challenging task for MANET due to high node mobility various routing protocols have been developed where dynamic optimization in routing is utilized for finding paths that satisfy some optimality criterion (shortest distance, minimal bandwidth usage and minimum delay) and constraints (limited power and limited capability of wireless links). Proactive, reactive and hybrid are the major categories of routing protocols.

The QOS parameters of MANET is done by GA application. As the designing of a QOS routing approach is the most challenging issue in MANET therefore; GA is utilized for the selection of the most optimal (fittest) route from source to destination, from a set of routes having their corresponding connectivity qualities. The GA based QOS routing methodology in the following sections selects the fittest route and optimizes various performance parameters like average packet delivery ratio, average packet drop rate, average end-to-end delay and average hop count. Simulation study justifies that optimized genetic stowed approach to potent QOS in MANET improves the performance factors when compared with conventional routing approach.

1.1 QOS PROTOCOL PERFORMANCE ISSUE/FACTORS

Even after overcoming the challenges of MANET, a number of factors [26] have major impacts while evaluating the performance of QoS protocols. Some of these parameters are of particular interest considering the characteristics of the MANET environment. They can be summarized as follows:

Node mobility: This parameter has been the focus of research studies such as [11]. This factor generally encompasses several parameters: the nodes' maximum and minimum speed, speed pattern and pause time. The node's speed pattern determines whether the node moves at uniform speed at all times or whether it is constantly varying, and also how it accelerates, for example, uniformly or exponentially with time. The pause time determines the length of time nodes remain stationary between each period of movement. Together with maximum and minimum speed, this parameter determines how often the network topology changes and thus how often network state information must be updated.

Network size: Since QoS state has to be gathered or disseminated in some way for routing decisions to be made, the larger the network, the more difficult this becomes in terms of update latency and message overhead. This is the same as with all network state information, such as that used in best-effort protocols [3];

Node transmission power: Some nodes may have the ability to vary their transmission power. This is important, since at a higher power, nodes have more direct neighbors and hence connectivity increases, but the interference between nodes increases as well. Transmission power control can also result in unidirectional links between nodes, which can affect the performance of routing protocols. This factor has also been studied extensively, e.g. [4, 3, 2]; Channel characteristics: As detailed earlier, there are many reasons for the wireless channel being unreliable, i.e. many reasons why bits, and hence data packets, may not be delivered correctly. These all affect the network's ability to provide QoS.

2. Gefnetic Algorithm

Genetic algorithms (GAs) are computer programs that mimic the processes of biological evolution in order to solve problems and to model evolutionary systems [5]. Genetic algorithm starts with initial population that randomly generated set of solutions. Each solution is consisting of a fixed length string of binary numbers. Fitness is evaluated with each solution. The fitness evaluation is based on the objective function. Each bit of the string is called gene and each string representing the solution is called chromosome. The set of strings is called population. Genetic Algorithm generates new population of chromosomes by selecting the better fit solutions from existing population and applying genetic operators to produce new offspring of the solutions. The process is repeated successively to generate new population iteratively. In this way every successive population is better fit then the previous population .This process is repeated until some criterion is met or a reasonably acceptable solution is found.

2.1 Genetic Algorithm in Unicast and Multicast

When a source node wants to transmit some data to a destination node, it needs route from itself to the destination. If it is not, it initiates the route discovery process [6]. The source node broadcasts a route request packet (RREQ) to the destination node. When each node receives the RREQ, it creates or updates a reverse route to the source node in the routing table. If it does not have a valid route to the destination node in the routing table, it rebroadcasts the RREQ. If node N receive RREQ packet and it is destination node, it first appends the RREQ packet information to its own routing table and after that uses the route quality factor that is the fitness function it evaluates. It appends this value to the route reply (RREP) packet and backwards the RREP packet to the source node through same path. The destination node does this operation for all received RREQ packets. The route quality factor value is the main parameters for route selection.

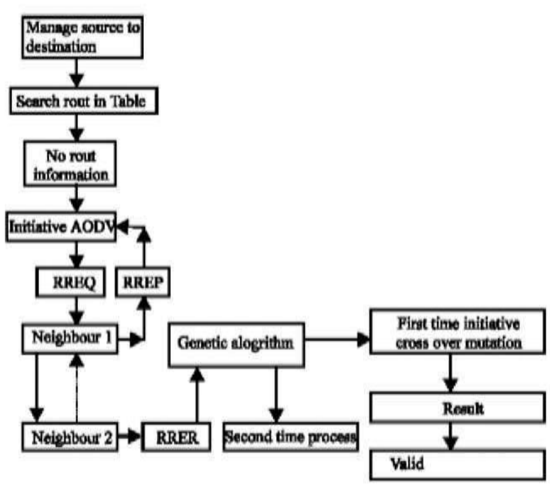


Fig. 1. Unicast routing using Genetic Algorithm

In our proposed protocol, each RREQ packet records information of all link positions and nodes along traversed path. Link position information is delivered from the source node to the destination node. The destination node may receive link position information from different RREQ packets; it means that there are different feasible paths. Finally, required computation for route selection is accomplished at the destination node and result is backward to the source node in order to decide route.

The proposed genetic based unicast routing algorithm is shown below.

- The current node detects link break to the upstream node and notifies link break to the current node.
- The notified node sets the weak state to the routing flag of the route entry that the next hop is the current node. After that, the received RREQ that the current node has transmitted, is discarded and not processed for a while.
- When the notified node is close to the destination node, it performs the local repair.
- After that, when the notified node receives the RREP, it alternates to a new route via crossover instead of the route that the routing flag is on the weak state.
- When the notified node is far from the destination node, it transmits the RERR with setting the flag, which the route is not made invalid when each node receives this RERR.
- The destination node which received this RERR sets the weak state to the routing flag of the route entry that the next hop is the notified node, and it transmits this RERR again.
- The source node which received this RERR sets the weak state to the routing flag similarly, and it broadcasts the RREQ to reestablish a new destination route.
- After that, when the source node receives the RREP, it alternates to a new route instead of the route that the routing flag is on the weak state.Multicast Using Genetic Algorithm

MAODV protocol builds on sharing of delivery tree to support multiple senders and receivers in a multicast session. In MAODV, it consists of mainly two steps route creations and route maintenances. In our proposed protocol, as a tree-based multicast routing relies on flooding as a whole in entire network to discover the routing path and establish the multicast tree. When a source node wants to join a multicast group or has data to send to the multicast group, it will broadcast a route request (RREQ) message. The initial population is generated by encoding process. The strings that are generated from encoding process proceed with other operations like selection, crossover and mutation.

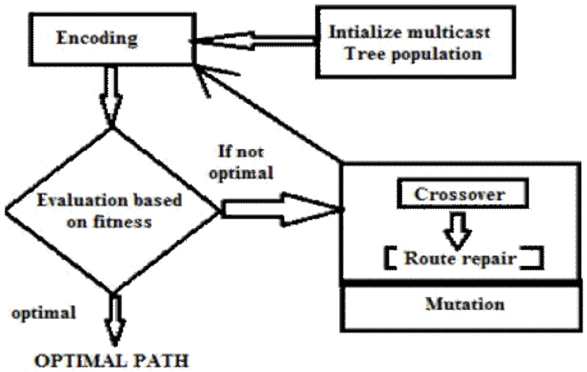


Fig. 2. Multicast routing using Genetic Algorithm

The source node is flooded along with route quality factor that is it evaluates the fitness function and based on fitness function; every node maintains a variable called advertised hop count for each destination along with time delay. This variable is set to the length of the longest available tree for the destination at the time of first advertisement for a particular destination sequence number. The advertised hop count along with time delay remains unchanged until the sequence number changes. Advertising the longest tree length permits more number of alternate trees to be maintained. These trees are then encoded between nodes establish reverse route and forward the Route Request message. After receiving a Route Request message, a route reply message is send by the members of multicast group to setup a forward path. The largest sequence number and the smallest hop count along with time delay receives one or more RREP messages by the source node from the destination nodes before timeout, Then it starts to send multicast data packets.

In route maintenance phase, whenever the route error will occur on-tree node notices a link broken. The node will delete from the upstream node in its next-hop list, drop the multicast data packets and reconstruct a new tree branch. The route maintenance will do rebroadcasting to find the valid route. During this phase, crossover and mutation will allow the solutions to exchange their information and hence search for paths that are more optimal. Crossover is applied in finding trees that are more suitable, satisfying the specified constraints. Crossover finds the selected trees are combined to give rise to new tree by dividing the chromosomes of parent trees and recombines them. Crossover from the chromosomes pool selects ones that are having greater fitness. This child tree that created by crossover undergoes mutation phase.

Mutation is a process of selecting the best one out of the multiple options left out by the crossover operation. Mutation process is one of the intelligent multicast selections which are better than the traditional method. Mutation is a technique in which reorganizing the genes of the chromosome is done in order to achieve specific characteristic in the organism. With 'diversity coding', an overhead is added to each data packet (coding) and the resulting coded packet is split into smaller blocks each of which is transmitted along a different tree path. With adequate redundancy this structure can improve the packet delivery probability in highly dynamic mobile networks. Mutant's tree paths are used simultaneously for load balancing where data packets are distributed over the available paths, thereby improving the network utilization and packet drop. The new tree is iterates and continues until an optimal multicast tree is obtained.

3. Simulation studies

The simulations have been carried out using the Network Simulator version 2 (NS-2) which is a discrete event simulator. NS-2 simulator is used for its low cost, wide scientific acceptance, availability of protocols, and support for developing protocols and adding new components. Network Simulators are an essential tool in research where new concepts in networking and communication are to be explored and different concepts are to be verified. The metrics has to be measured against some parameter that describes the characteristic behavior of an ad hoc network and can be varied in a controlled way. The parameters that are chosen to simulate with are:

- Mobility, which probably is one of the most important characteristics of an ad-hoc network. This will affect the dynamic topology; links will go up and down.
- Offered network load. The load that actually offer the network. This can be characterized by three parameters: packet size, number of connections and the rate that we are sending the packets with.
- Network size (number of nodes, the size of the area that the nodes are moving within). The network size basically determines the connectivity. Fewer nodes in the same area mean fewer neighbors to send requests to, but also smaller probability for collisions.

3.1. Simulation Setup

Table 1. Simulation parameter .

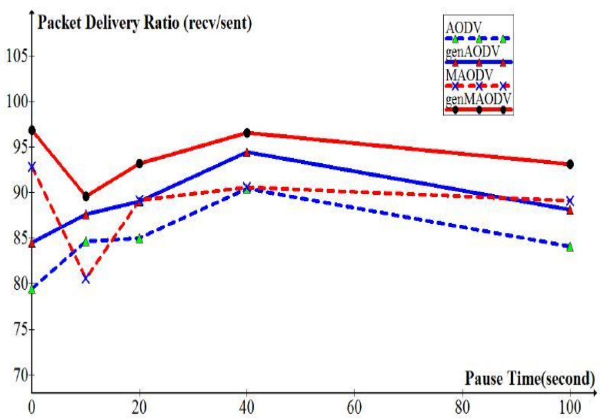
Parameter	Values
Channel Type	Wireless Channel
Radio Propagation Model	Two-Ray Ground
Network Interface Type	Phy/WirelessPhy
MAC Type	Mac/802_11
Interface Queue Type	Drop-Tail
Link Layer Type	LL
Transmitter range	250 m
Bandwidth	2 Mbit
Simulation time	250 s
Number of nodes	50
Traffic type	Constant Bit Rate

In Simulation environment network simulator version 2.33 has been used, which has support for simulating a multi-hop wireless ad-hoc environment. Nodes are deployed in an area of 1000 x 1000 m2. Each point in result is an average of 10 seeds

[9]. The other simulation parameters are summarized in the above table.

The following parameters have been considered for comparison:

- Packet Delivery ratio: the figure below shows the packet delivery ratio of two routing protocols and by using genetic algorithm. The Packet delivery ratio is improves in genAODV and genMAODV



- Fig. 3. Shows variation in Packet delivery ratio of these protocol
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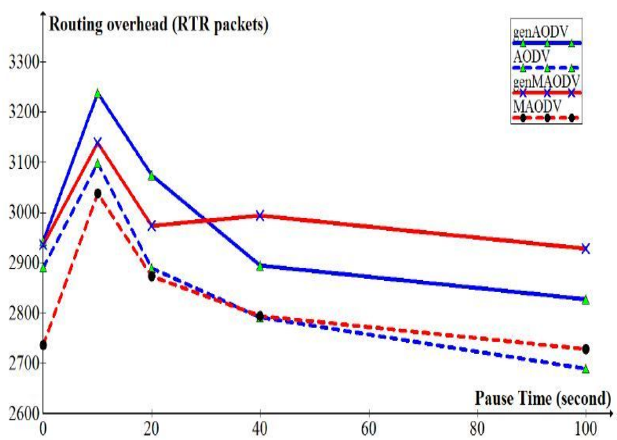
- Routing overhead: the figure below shows the routing overhead of two routing protocols and by using genetic algorithm. genAODV and genMAODV increases the routing overhead that is The number of



routing packets transmitted per data packet delivered at the destination has increased.

Fig. 4. Shows variation in routing overhead of these protocol

- Packet Dropped: the figure below shows the packet dropped of two routing protocols and by using genetic algorithm. The packet dropped is decreased in more in genAODV and well as in genMAODV.

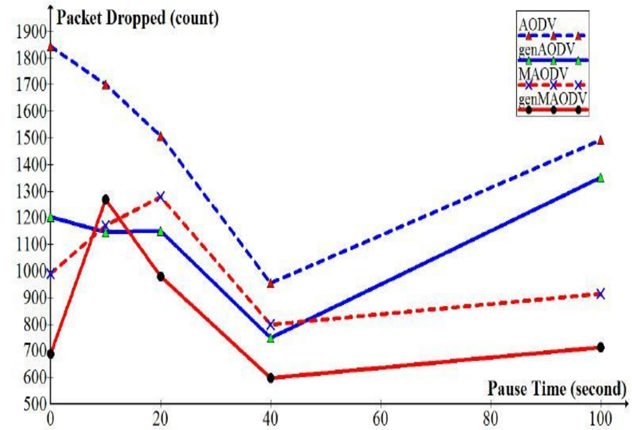


Fig. 5. Shows variation in Packet dropped of these protocols

4. CONCLUSION

In this paper, proposed AODV using genetic algorithm which avoids route breaks based on AODV in ad-hoc routing protocols. It is the algorithm where each intermediate node on a route detects the link and is avoided by re-establishing a new route with our proposal algorithm before route breaks. From the results of computer simulations, it is shown that AODV with genetic algorithm is more effective than AODV. Similarly, multicast routing protocol has been designed. The use of genetic approach in finding the multicast routes bring optimality and expected performance of the protocol. The QOS tries to develop a network on which genetic algorithm is applied to generate an optimized path. Hence genetic based algorithm plays an important role in performance improvement in MANETs.

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