A Proposed Route Selection Technique in DSR Routing Protocol for MANET

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***Abstract*--** **This paper presents a novel technique for optimizing the efficiency of route discovery. The optimization aims to minimize the number of cached route request (RREQ), which is a significant source of overhead for the dynamic source routing (DSR) protocol. Our proposed technique is based on a decision algorithm that weighs individual links as a path to the necessary destination is being constructed if this link is deemed suitable by the fuzzy logic system it is added to the path and route construction continue. The fuzzy controller is used to instruct route construction continue as only good quality links are recorded in source destination paths.**

A productive decision using a fuzzy logic system is applied to the route discovery technique to curb non-optimal network floods. This action causes a cessation in the generation of low quality routes as only paths with good routing metrics are selected for the rebroadcast of route discovery packets. Consequently, route query packets arriving at the necessary destination node, or at some intermediate node with knowledge of the destination node, generate high quality route replies

Performance results show that the propagated route request overhead can be reduced by more than 30% under high node mobility. Also, our proposed algorithm can significantly reduce the average end-to-end delay.

Furthermore Simulation results show that the packet delivery ratio increases when proposed algorithm is used in comparison with the standard DSR routing protocol.

***Index Term*--** **MANET, New routing protocol for MANET, DSR.**

1. INTRODUCTION

A Mobile Ad hoc Network (MANET) is a dynamic wireless network with or without fixed infrastructure. Nodes may move freely and arrange themselves randomly. The contacts between nodes in the network do not occur very frequently. As a result, the network graph is rarely, if ever, connected and message delivery required a mechanism to deal with this environment [1] Routing in MANET using the shortest-path metric is not a sufficient condition to construct high-quality paths, because minimum hop count routing often chooses routes that have significantly less capacity than the best paths that exist in the network. [2] Most of the existing MANET protocols optimize hop count as building a route selection. Examples of MANET protocols are Ad hoc On Demand Distance Vector (AODV) [3], Dynamic Source Routing (DSR) [4], and Destination Sequenced Distance Vector (DSDV) [5]. However, the routes selected based on hop count alone may be of bad quality since the routing protocols do not ignore weak quality links which are typically used to connect to remote nodes. These links usually have poor signal-to-noise ratio (SNR), hence higher frame error rates and lower throughput. [6,7].

The wireless channel quality among mobile nodes is time varying due to fading, Doppler Effect and pathloss. Known that the shortest-path metric does not take into account the physical channel variations of the wireless medium, it is desirable to choose the route with minimum cost based on some other metrics which are aware of the wireless nature of the underlying physical channel. In MANET, there are many other metrics to be considered: Power, SNR, Packet Loss, maximum available bandwidth etc. These metrics should come from a cross-layer approach in order to make the routing layer aware of the local issues of the underling layers. [8].

The ability of MANET to provide acceptable quality of service (QoS) is restricted by the ability of the underlying routing protocol to provide consistent behavior despite the inherent dynamics of a mobile computing environment. [9, 10].

Many proposals and models addressed quality of service (QoS) among mobile nodes of the wireless networks and considered the link quality in their designs and architectures [11-13].

The GPS [14-17] and signal strength methods both use physically measured parameters to predict the link status. The node with GPS can know the position of itself directly. But GPS currently is not a standard component of mobile devices and in the metropolitan area and indoor, the signal can be too weak to be received.

This paper is structured as follows: We investigate the proposed technique in section 2. Section 3 elaborates on the simulation environment and the experimental results. In Section 4, we present our conclusion.

2. A PROPOSED TECHNIQUE

In DSR as a route request is flooded through the network, nodes append their own address to the route record and rebroadcast the request. It is proposed here that nodes that appear in this route record should determine whether or not to continue with the route discovery process. Route metrics that are used to make this decision are link strength, energy available at a link vertex, and number of hops currently in a path.

It is proposed here that the metrics link strength, energy available at a link vertex, and number of hops in a path will be combined into a single decision thereby optimizing a routing protocol over a number of metrics and making it more robust. The decision to continue with a network broadcast will be determined via a fuzzy logic system being applied to a fuzzifier that translates them into fuzzy sets. The fuzzy sets are used to appraise each constraint as being Low, Medium or High, assigning each a value between {0, 1}. These evaluations are passed to a fuzzy inference engine that applies a set of fuzzy rules that determines if a route is apt for continue or not. If a route is deemed suitable then the route request is rebroadcast and the node extracts and caches the route record. When a route request arrives at the necessary destination a route reply is generated and sent to the initiator of the route request by reversing the path stored in the route record.

Example fuzzy rules for both *To continue* and *Not To not to continue with the route discovery process* conclusions are given below:

IF (LS=High) AND (NE= High) AND (NH=Low) THEN continue to rebroadcast
IF (LS=Low) AND (NE=Low) AND (NH=High) THEN stop rebroadcast

Where:

LS = Link Strength
NE = Node Energy
NH = Number of Hops

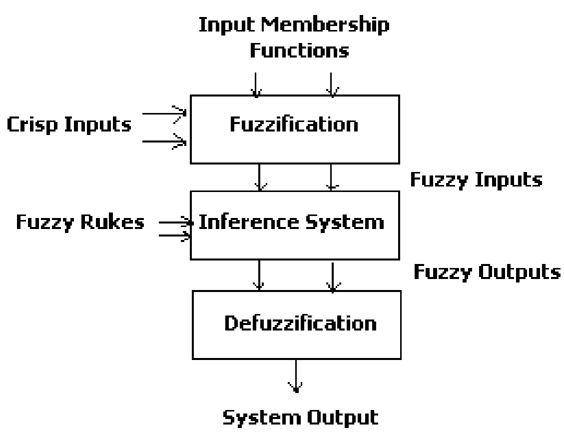

Fig. 1. Fuzzy Logic System

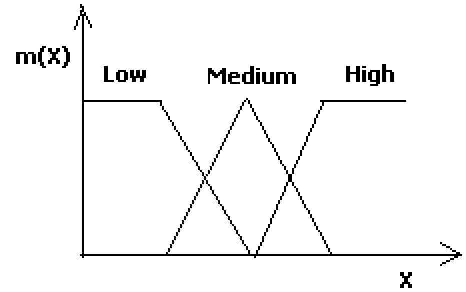

Fig. 2. Fuzzy Logic Membership Function

The decision to or not continue with a route request rebroadcast is made by using the min-max rule, with the minimum value of the *To continue* rule set being taken as the outcome and likewise for the *Not To continue* set. The maximum value of these two outcomes is then selected as the conclusion for the decision.

Due to the broadcast nature of route discovery techniques network resources can be unnecessarily used in this network wide propagation that often leads to the selection of unstable paths. Unstable path are classified as paths that have a large associated signal loss, consists of low-energy nodes, high number of hops or paths spread over a large distance between source and destination. So as to eliminate unsuitable paths from the route discovery/reply process and to optimize the decision for broadcast floods are only continued if a node's fuzzy system indicates that it is valid to do, when the source node initiates route discovery when it wishes to transmit a packet to a destination. To do so, the node broadcasts to its local neighborhood a route request RREQ for the necessary destination and using the following process:

```
IF the node is the destination
      Apply fuzzy
      IF fuzzy is ok?
            Receives RREQ
      ELSE IF
            Ignores RREQ
      END IF
ELSE IF the node receives RREQ
      Apply fuzzy
      IF fuzzy is ok?
            Rebroadcasts RREQ
      ELSE IF
            Ignores RREQ
      END IF
END IF
```

Fig. 3. Route Discovery/Reply Process

3. PERFORMANCE EVALUATION

3.1 Simulation Setup

Simulation is done on the GloMoSim developed at the UCLA labs [18]. It is being used to test the protocols of the wireless networks. The simulator provides a proper model for the signal propagation and its radio model supports a 2Mbps of transmission rate and 100 meters of transmission range. The

IEEE 802.11 was simulated at the MAC layer, with the implementation of the distributed coordination function (DCF).

In this simulation, 50 mobile nodes move within a rectangular field of 500m x 500m in size. We choose this rectangular field so that the average hop distance between any two nodes will be larger than that of a square field with the same area. The duration of each run is 100 simulated seconds. The mobility model uses the *random waypoint* model. The radio model used is the *two ray* model. We change the mobility rate by setting different values to pause time as 0, 10, 20, 50 and 100 simulated seconds. Here, a pause time of zero means continuous mobility and 100 seconds reflects stable nodes. The maximum moving speed can be 20m/s. We run simulations covering each combination of pause time and moving speed. For the traffic model, we use 20 simultaneous sessions with source-destination pairs spreading randomly on the whole network. Traffic sources are constant- bit-rate, sending 4 UDP packets a second. Each packet is 512 bytes long, thus resulting 2K byte per second data transfer rate for each session.

3.2 Performance Metrics

The performance of the proposed routing algorithm is gauged in terms to the following metrics:

- ***Route request overhead:*** is the number of propagated RREQ packets by protocol, including those route request packets forward by intermediate nodes.

- ***Packet delivery Ratio:*** it is the ratio of the number of packets which received successfully and the total number of packets transmitted.

- ***Average end-to-end delay:*** the end-to-end delay is averaged over all surviving data packets from the sources to the destinations.

The simulation results are presented in the next section.

3.3 Simulation Results

The results obtained after simulation are compared with the well known reactive routing protocol DSR. Figure 3 shows the propagated RREQ packets for DSR with our proposed DSR-RS (DSR with route selection) and the standard DSR.

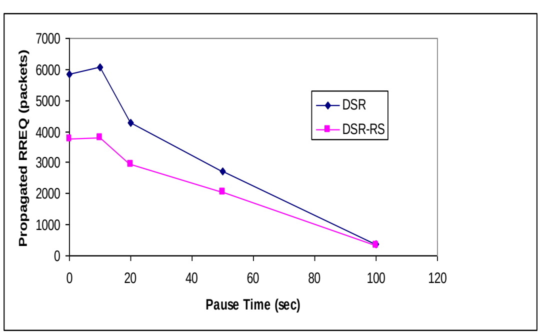

Fig. 4. Propagated RREQ vs. Pause time

It is noticed that the route request overhead value of DSR-RS is lower than DSR routing algorithm. This is the result of reducing the route request overhead with the proposed algorithm especially in case of high mobility. Reducing route request overhead in network will supply effective usage of bandwidth and energy consumption.

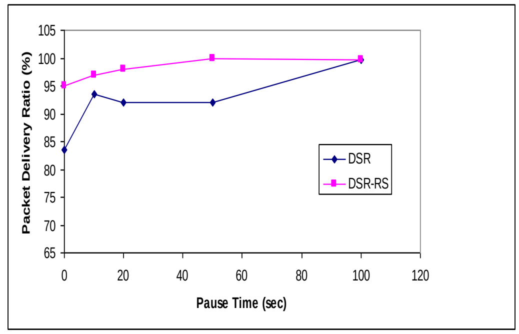

Fig. 5. Packet delivery fraction vs. Pause time

Figure 4 shows the packet delivery ratio of DSR-RS compared with DSR. The packet delivery ratio is higher for our algorithm as it is compared with DSR routing algorithm.

DSR-RS was compared with DSR in terms of average end-to-end packet delay in Figure 5.

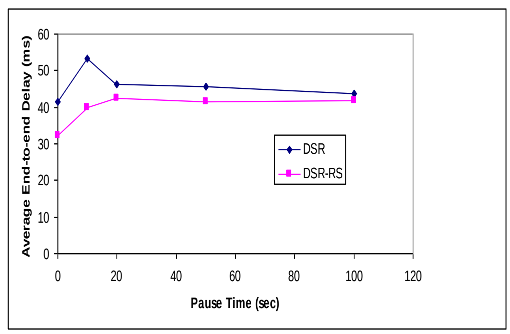

Fig. 6. Average end-to-end delay vs. Pause time

It is noticed that the DSR-RS has better performance than the DSR algorithm.

4. Conclusion

In this paper, we propose a fuzzy logic based rebroadcasting decision as a route selection method. This facilitates the generation of effective decision that limits the necessity for route discovery floods. In conjunction with this, nodes can decide to end a route discovery flood if they select themselves as being unsuitable for routing through self-monitoring. This cumulative path fuzzy logic system also generates route replies only for selected routes and not for all available routes as is usual with DSR.

The proposed DSR-RS algorithm is compared with the DSR algorithm in terms of route request overload, packet delivery ratio and end-to-end packet delay.

It was observed from performance simulation that the DSR-RS gives better results than DSR algorithm especially in the case of high mobility. The DSR-RS algorithm uses available bandwidth efficiently because of its high packet delivery ratio and low route request overload. The algorithm is not affected with the number of nodes increased in the network.

Furthermore, Results show that fuzzy logic based rebroadcasting decision making enhances protocol performance as the route request overhead is lessened and the end-to-end delay associated with packets is reduced. Also, the packet delivery ratio is higher for our proposal as it is compared with DSR routing algorithm.

The improved protocol performance can be attributed to the fuzzy system as is selects stable routes i.e. routes with low signal loss, high energy nodes over a small number of hops.

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