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Optimized Path Selection based on Multi Criteria in MANET

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***Abstract*— 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 [7]. 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. In this paper, we propose a mechanism to choose the routing protocol based on multiple criteria like link stability, bandwidth, energy consumption etc. These paths are quite efficient. Network performance will be increases by using these paths .**

Keywords: MANET, Multicast AODV, Neighboring node Stability, Reliability, Routing Protocol

INTRODUCTION

With the development of the internet, there are many multicast businesses emerge such as mobile video conference, emergency communication, GPS navigation and so on. These multicast businesses are based on multicast protocol. The stability requirements of transmission are very high because they are real-time businesses. But in mobile Ad-Hoc network, the unpredictable movement of nodes will lead to the frequent, fast change of network topology. The bandwidth of wireless network is narrower compared with wired network. The transmission distance of every node in wireless network is limited. Not all the message is able to transmit to destination node due to the channel error, transmission collision, multipath fading or multi-access interference. In order to provide the communication across the whole network, we need several intermediate nodes from source node to destination node. All this make the multicast routing technology of mobile AdHoc network more complicated.

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), Dynamic Source Routing (DSR), and Destination Sequenced Distance Vector (DSDV). 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[6,10].The wireless channel quality among mobile nodes is time varying due to fading, Doppler Effect and path loss. 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. [14].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.

In this paper, we explore the parameters to achieve the best routing path in the MANET network & propose routing protocol based on these parameters to choose the best path. We simulate the routing protocol in the MANET network with high mobility & traffic pattern to prove the effectiveness of the proposed solution.

LITERATURE SURVEY

Many of the proposed MANET routing protocols in the literature have limited provisioning for QoS and use paths discovered without regard to path reliability or longevity. Possessing a priori knowledge of the mobility-induced RPL in a path-selection algorithm will reduce the overhead as a result of fewer path failure notifications and of less need for path re-discovery. This in turn will make better use of the scarce bandwidth in the network.

The study of path selection based on mobility-induced RPL is a largely unexplored research field. Because of the difficulty in accurately modeling the multi-hop path,

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most published work takes the approach of extending the results of individual link lifetime to evaluate the overall path lifetimes. For example, Gerharz et. al. [8] proposed two methods to identify the "stable" links from several available links. Unfortunately, due to the correlation between adjacent links on a path, this approach often does not produce sufficiently good results.

One measure in assessing the stability of a link is the length of the *link age*, defined as the duration between the first moment a link is established until the observation time, assuming that at that time the link is still up. There are generally two approaches to selection of links based on their age: one favoring the use of younger links and the other advocating the choice of older ones. Gerharz et. al.[5] examined the relationship between the age of link and its residual lifetime, based on which they proposed several methods to discover a stable path. One of their proposed algorithms finds a path whose age is below a certain threshold, although the threshold in their paper appears to be an arbitrarily chosen one. On the other hand, some routing protocols such as the Associativity-Based Routing (ABR) [15] consider older links to be more stable on the grounds that a link is likely to stay alive for a longer time period if it has already existed beyond a threshold time. However, we note that this assertion may only be applicable to certain mobility models, such as the Gauss Markov mobility model [6]. In our study, we consider that the choice of a link with an appropriate age, neither too young, nor too old, is very important in assessing its stability. In order for a path-selection algorithm to be applicable to a wide range of mobility scenarios, its decision-making operations should be independent of the mobility attributes. For example, the random waypoint mobility model uses *pause time* for a node as a mobility attribute [7], which dictates how long a node may pause before moving on to the next destination. This attribute value has a significant impact on the dynamics of the network topology [2].

Tsirigos and Z.J. Haas [3] proposed the Distance-Based Energy Efficient sensor Placement (DBEEP) for lifetime maximization, which jointly optimize the load balance, communication range, and network size in a time-driven linear WSN. DBEEP identifies the traffic load balancing as a critical issue that must be addressed at each node in a balanced traffic flow. This is important since the load balancing on a particular node can increase the network lifetime. The DBEEP comes with an energy model that assumes those nodes, which only relay data to the next node in the direction of the radius is lost. In this model, the configuration refers to the arrangement of those related nodes that are deployed along the radius. If the adjacent node have d1>d2...>dn, the connected coverage of the inside nodes will be ensured. Similarly, C.-K. Toh [15], described the control of energy consumption can be done by controlling the optimum router location, identifying the number of nodes involved, and taking into account the communication costs and the shortest route.

Most of the existing works in the literature focus on single parameter for route selection like link stability, energy consumption, delay, available bandwidth etc. These are no comprehensive approach which is based on multiple parameters to select the best routing path. In this paper, we propose an approach based on the multiple parameters – Link stability, energy consumption, available bandwidth, and delay in the link.

OVERVIEW OF PROPOSED SOLUTION

Our proposed solution consists of two parts

1. Proactive learning of parameters
2. Routing based on optimal value of parameters.

In our mechanism, the routing is based on multiple criteria. Based on multiple criteria, each node associate a fondness value to its neighboring node , during routing process, it choose the neighboring with larger fondness value for the routing the packets. This process is explained in detail in below section.

DETAILS OF PROPOSED SYSTEM

A. *Proactive Learning of Parameters*

We follow a proactive learning mechanism in the project. Each node will advertise certain parameters to its neighboring node. The advertising process is done only when change is there in the parameters or on node movement.

Following parameters are advertised

1. Energy remaining at the node (E)

2. Average delay in last sampling period (D)

3. Average packet drop ratio in the last sampling period (P)

4. Link stability ratio (L)

Link Stability (L) can be calculated based on the distance between the nodes. A link stability can be determined by considering the following decisions.

- Decision 1: If node n_{i-1} and node n_i are very close at timestamp ts, that is $Dist(n_{i-1}, n_i, ts) \leq Dist_{min,}$ then stability $L(n_{i-1}, n_i, ts)$=MAX
- Decision 2: If node n_{k-1} and n_k are closing at each other, that is $Dist(n_{i-1}, n_i, ts_i) \leq Dist(n_{i-1}, n_i, ts_{i-1})$, then stability $L(n_{i-1}, n_i, ts)$=MAX
- Decision 3: If $Dist(n_{i-1}, n_i, ts) > Dist(n_{i-1}, n_i, ts_{i-1})$ then the degree of lasting connection of node n_{i-1} and $n_{i,}$ $f(n_{i-1}, n_i, ts)$ is

$f(n_{i-1}, n_i, ts) = Dist_{max} - Dist(n_{i-1}, n_i, ts) /$

$Dist(n_{i-1}, n_i, ts) - Dist(n_{i-1}, n_i, ts_{i-1})$

- Decision 4: Stability $L(n_{i-1}, n_i, ts)$ = MAX, when $f(n_{i-1}, n_i, ts) \geq f_{max}(n_{i-1}, n_i, ts)$ and conversely, $L(n_{i-1}, n_i, ts) = 0$, when $f(n_{i-1}, n_i, ts) < f_{max}(n_{i-1}, n_i, ts)$

Based on all these parameters fondness value is calculated at each node for its neighboring node.

$$F = a*E + b*D + c*P + d*L$$

Where a, b, c, d are the weight values from 0 to 1. The values are assigned weights in such a way to the parameter user wants to give more importance in the fondness factor calculation.

Each node maintains the fondness value for every neighboring node to which it has links.

B. Routing based on Fondness value

AODV protocol is customized to work based on fondness value instead of on hop count.

Whenever destination node sends a route-reply it will fill the fondness value with its previous hop node in the route reply packet and sends to the previous hop node. When the forwarding node receives the route reply, it will fill the minimum of the fondness value in the route reply & its fondness with its neighbor node. When the route reply reaches the source node it will have the fondness value in each path towards to the destination. Source node will choose neighbor node with the greatest fondness value as its next hop node. At each hop the node with greatest fondness value is chosen.

IMPLEMENTATION OF PROTOCOL

The basic operation process of the proposed protocol is:

1. As and when a node enters a multicast group, it propagates its parameters such as Energy Remaining at node(E), Average delay (D) & Average pack drop ratio(P). The receiving adjacent nodes calculate the link stability ratio with respect to the initiative node and calculate the fondness values.

2. When a node has some data to be sent to a destination or if it wants to join a multicast group to which it has no route in the cache, then the node initiates a route determination mechanism. To determine the route to a destination, the node must initiate a route request (RREQ) packet and sends it to the desired multicast group.

3. When the RREQ packet is received by an intermediate node, we will check whether the intermediate node is the member of the multicast group or not. If yes, route entry is checked to the destination in the intermediate node. Then the serial number of intermediate node is compared with the serial number of the RREQ packet. If both the serial numbers match, then we compare the link stability L with the minimum threshold value and fondness values of all neighboring nodes are compared with one another. If the Link Stability L is less than the threshold, the current node of the multicast group is ignored or discarded. Then the fondness value of that node is degraded, as its fondness value is low. This is done for every node that is discarded or ignored. The node with high fondness and link stability greater than the threshold is selected for the route and the fondness of node is updated. Later the fondness value of the node is upgraded, which specifies that the node is a well known one.

4. When the RREQ packet reaches the destination, the route is updated in the route table of destination node. Now a RREP is generated by destination and the reverse route to source is copied into RREP and is sent to source based on the reverse path.

5. From all the received replies, source node selects the rote of RREP packet that has high sequence number, biggest Link stability and highest fondness. To specify the selection of path to intermediate nodes, the source node sends a Multicast Activation, MACT to the nodes in selected route. The remaining nodes discard the routes as they didn’t receive any MACT. MACT is sent along the route until it reaches the node that initialized RREP. After successfully sending the MACT message, the source node starts sending the message packets through the selected stable path.

PERFORMANCE ANALYSIS

We implemented the proposed routing protocol in NS2 simulator. Table 1 shows the parameters considered for simulation.

Num of Nodes	100
Comm. Range	200 m
Simulation area	1000 * 1000 m
Weight values for fondness	0.5 ,0.2 , 0.2 , 0.1
Mobility Speed	10 m / s to 50 m/s
Initial Energy of Node	100J
Transmission Energy	0.6 J
Receiving Energy	0.2 J

Table 1: Parameters Considered

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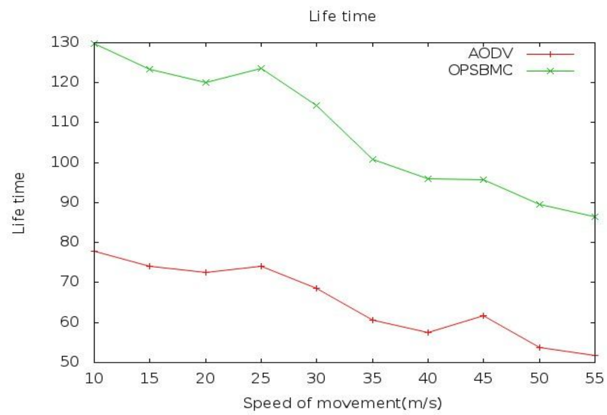

Fig 1: Speed of Nodes Vs Lifetime

We measured two parameters throughput & life time of the network. Fig 1 shows the graph plotted across speed of nodes Vs Lifetime and Fig 2 shows the graph plotted across speed of nodes Vs Throughput. We compared the performance of our proposed routing protocol with AODV protocol. We found that our proposed routing protocol is able to increase the throughput by 40% and life time is increased by 30%.

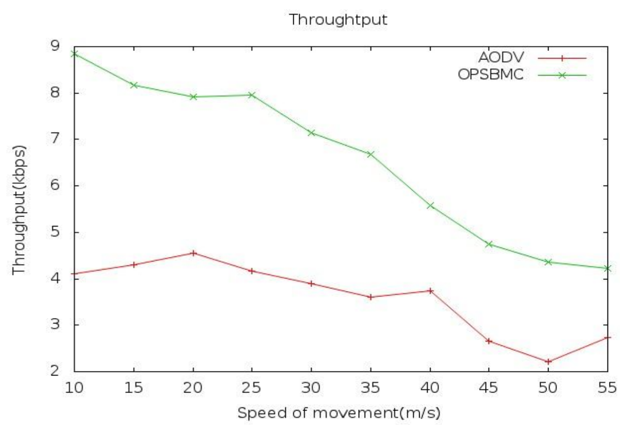

Fig 1: Speed of Nodes Vs Throughput

CONCLUSION AND ENHANCEMENTS

In this paper, we have detailed route selection protocol based on multiple criteria. Unlike the existing protocols, the proposed one improves the throughput and life time of the system by Proactive Learning of Parameters and by considering nodes that have higher energy. The efficiency of the proposed routing protocol have been proved in NS2 Simulator.

In the current approach weight values are by the user based on the criteria to be maximized. In future we want to implement a heuristic to choose the weight values to maximize the criteria.

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