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Optimization of an Efficient Routing Protocol in Mobile Ad-Hoc Networks

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Abstract— In mobile ad-hoc network (MANET), a host may exhaust its power or move away without giving any notice to its intermediate nodes. It causes changes in network topology, and thus, it significantly degrades the performance of a routing protocol. Several routing protocol studies are based on node quality and find node minimum distance path. In an estimated distance (EstD)-based routing(EDRP) protocol to steer a route path in the general direction of a destination, it can restrict the propagation range of route request (RREQ) and reduce the routing overhead. The EstD is a combination of EGD and ETD protocol. In the protocol, every node evaluates the link quality through the process of the EGD to eliminate the weak links and then uses the EstD to steer the RREQ packets. We proposed we implement the optimized Link State Routing Protocol for to dissemination of data over the nodes in mobile ad-hoc networks. In simulation results show that the proposed protocol significantly reduced routing overhead, improve the routing performance and reduce the time delay.

Index Terms— Distance estimation, mobile ad hoc networks (MANETs), route discovery, routing overhead, route request, route reply, Estimated geometrical distance, route error.

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1 INTRODUCTION

A mobile ad hoc network (MANET) consists of many mobile nodes that can communicate with each other directly or through with neighboring nodes. Often, hosts in a MANET operate with batteries and can roam freely, and thus a host may exhaust its power consume of move away, giving no notice to its neighboring nodes, changes in network topology. A key characteristic of these scenarios is the dynamic behaviour of the involved communication partners.In propose a novel route discovery mechanism based on the estimated distance (EstD) to reduce the control overhead of routing protocols in MANETs. Many routing protocols have been proposed for MANETs in the last few years. According to whether they depend on physical position knowledge, these protocols can be divided into topology- and location-based protocols. The topology-based routing protocols use link information to establish a path construction. When a node needs to discover a route, it broadcasts a route request (RREQ) packet to its neighbors. Due to many lack of position information, each node consists blindly rebroadcasts the received RREQ until the route is established. Although flooding is an effective mechanism for route discovery path, it propagates the RREQ through the entire network, which is an unnecessary routing operation. Position-based routing protocols that know the physical position of the nodes have a feature to restrict the propagation of RREQ packets within a narrow region. However, the position of geo- graphic knowledge is not available in many scenarios. In the absence of positioning service, we need to find a method to estimate the distance or direction to the destination. Thus, we combine the location-based routing features into on-demand routing protocols and propose an EstD-based routing protocol in the absence of positioning service to improve the route discovery.

1. We propose an algorithm to estimate the distance of two nodes without location service. The EstD includes two parts: a) the estimated geometrical distance (EGD), which is based on the change regularity of the received signal strength (RSS) at the contact time of two nodes to estimate the future geometrical distance after the nodes have parted from each other
2. We propose a method utilizing the computational process of the EGD to evaluate the quality of link between neighbors and then exclude the weak links. This is very important for routing protocols because it can reduce the frequency of path failures and route discoveries.
3. By the combination of exclusion of weak links and utilizing the EstD (EGD and ETD) to steer the propagation direction of RREQ packets to the general direction of the destination, the protocol can significantly reduce the routing overhead and improve the routing performance in dense or high-mobility networks.

2 DISTANCE BASED ON CHANGE REGULARITY RSS

This section describes the computation of EGD and analyzes the properties of the EGD.

2.1 Computation of EGD

To estimate the future geometrical distance of two node pair after the two nodes left each other's transmission range, are in contact time. The change regularity of distance in contact time can be used to estimate the future distance because the

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mobility process has a locality. . The computation of the EGD is similar to the connection lifetime prediction algorithm is to estimate the distance when the link breaks and to obtain the link quality (LQ).we assume that the RSS can be used to compute the distance between two nodes. The researchers in positioning have taken into account the error of RSS and have obtained many valuable results that can be used in our routing mechanism. We assume that nodes N_i and N_j move at velocities of v_i and v_j. If we consider node N_i as a reference frame, then node N_j moves at a relative velocity of $v = v_j - v_i$. According to the locality feature, node N_j keeps this relative velocity in some distance.

$$D(t) = At^2 + Bt + C$$

Now, $EGD(t) = D(t) = At^2 + Bt + C$ is represented a function of time t, and t is the difference between the current time and the time of the third to the last packet received from node N_j.

2.2 Properties of EGD

To observe the relationship between the EGD and the actual distance, we plot the empirical conditional mean of the actual distance between node pairs, conditional on their EGD. Fig. 1 shows this empirical mean of the distance for the RWP model, over a rectangle surface, whose length is 1600 m and its width is set from 600 to 1600 m

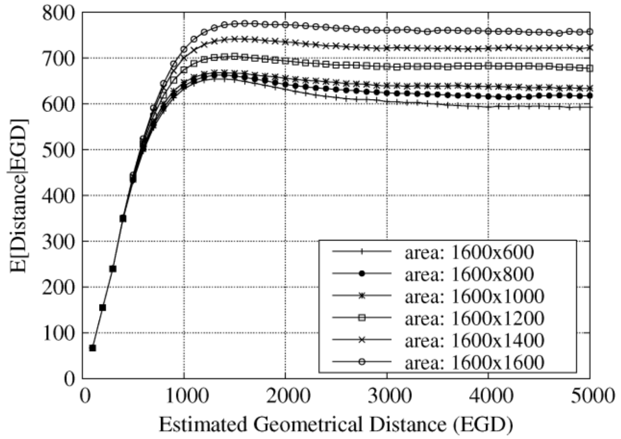

Fig. 1. Empirical mean of distance conditional on the EGD. It is good practice to briefly explain the significance of the figure in the caption to geometrical distance and node life time.

3 THE PRINCIPLE OF EDRP

In EDRP has introduced the applications of the EGD, and introduce a method to amend the EGD.

3.1 Evaluating the LQ using EGD

The calculation method of the EGD naturally has the ability to evaluate the LQ. Each node knows the EGDs of its neighbor nodes, and thus, from the first two relations of (1), the node can solve the relative velocity v with its neighbor nodes. We use D_2 and D_1 to determine whether a neighbor node is coming nearer or going away. If the neighbor is coming nearer, then this link may be strong; otherwise, we use a simple method to estimate the LQ. In function Link Quality(pkt), Tx_ Radius is the transmission radius of a node, and STRONG_LINK_THRESH is a threshold that is used to determine whether the link is strong or weak. This function can be used by the node to evaluate the LQ with its neighbor node when receiving a pkt. This LQ is used to determine whether this node is a valuable candidate to forward an RREQ packet, because selecting a weak link may lead to a path disconnection a short time later..

3.2 Amending the EGD Using ETD

Using the EGD to estimate the actual distance is effective when it is less than the E-Radius. As time goes by, if the two nodes do not encounter for the second time, then the EGD may become very large, which cannot correctly estimate the actual distance. For a large EGD, we need a criterion to check its effectiveness. Using RSS, we can estimate the distance between neighbors, and in multi hop networks, the sum of the distance of every hop can be used as a criterion. This distance is called the ETD because it is on the topology of the network and is not a geometrical distance. The ETD is computed as follows.

We modify the RREQ and route reply (RREP) headers and add a new field ETD. When a source node sends an RREQ packet, it sets to ETD = 0. The intermediate node receives this packet and can calculate the distance d from the previous hop node and then sets to ETD = ETD + d. Obviously, the sum of the distance of every hop must be greater than or equal to the geometrical distance. To reduce the error of EGD and ETD, EGD < ETD, then we determine that the EGD is effective, and then we use EGD to substitute the ETD. On the other hand, if ETD < EGD, we determine that the EGD is ineffective, and then we set to EGD = ∞. The following nodes (including the destination node) do a similar procedure when receiving an RREQ packet. Thus, the destination node can estimate the topological distance to the source node. When the destination node replies an RREP packet to the source node, it does a similar procedure as the source node, and so do the intermediate nodes and the source node when receiving an RREP packet. After that, the source node can also estimate the topological distance to the destination node. As historical information, the ETD has a lifetime ETD_LIFETIME. Thus, the ETD is also a function of time. If the ETD_LIFETIME expires, then we set ETD = ∞. Note that the ETD is either a topological distance in recent time or ∞. If the ETD of a node to the destination is less than ∞, then it must have a route to the destination in recent time.

From the computation of the ETD, we know that if EGD< ETD, then the EGD is effective, and if ETD < EGD, then ETD is effective. Therefore, the EstD should be the minimum of EGD and ETD, which is defined as follows:

$$\text{EstD} = \min\{\text{EGD, ETD}\}.$$

4 EXPRIMENT RESULT

We compare the performance of our proposed protocol with that of other protocols using NS-2 simulator. We implement our proposed protocol by modifying the current AODV implementation in NS-2. We also compare the routing performance of the EDRP with that of the PGP. which is a similar protocol in recent literature, and the conventional AODV. The PGP uses hints that combine the elapsed and contact times between two nodes to estimate the distance of a node to the destination and uses it to steer the RREQ to the destination.

4.1 Protocol Implementation

We evaluate the protocols using the following performance metrics.

1. Normalized number of RREQ packets: It is defined as the ratio of the total number of RREQ packets to the total number of data packets delivered to the destinations. For the RREQ packets sent over multiple hops of packets and each single hop is counted as one transmission.
2. Normalized routing overhead: It is defined as the ratio of the total packet size (bytes) of control packets [including RREQ, RREP, route error (RERR), and Hello] to the total packet size (bytes) of data packets delivered to the destinations. For the control packets sent over multiple hops packets, each single hop is counted as one transmission. To preserve fairness, we use the size (bytes) of control packets instead of the number of control packets, because the EDRP protocol adds two extra fields EstD and ETD in the RREQ packet and one extra field ETD in the RREP packet, and both sizes are bigger than the size of the original AODV.
3. Packet delivery ratio: It is defined as the ratio of the number of data packets successfully delivered to the total number of data packets generated by the CBR sources.
4. Average end-to-end delay: It is defined as the average delay of a successfully delivered CBR packet from the source node to the destination node. This delay includes all possible delays caused by buffering during routing path discovery, queuing at the interface of path queue, retransmission at the MAC layer, propagation range, and transfer time.

4.1 Protocol Analysis

In the protocol analysis, we pay attention to the routing performance of the PGP and EDRP, compared with an Omni directional protocol, i.e., the conventional AODV. As mentioned in node density is an important factor that affects the performance of geographical forwarding; in the protocol analysis, we fix the maximum mobility speed to 15 m/s but vary the number of nodes from 50 to 200 to represent different node densities. The analysis results are shown as follows. The normalized number of RREQ packets is metric reflects the direct effect of the optimization method. The normalized routing overhead is shown in Fig2. The routing control overhead includes RREQ packets, RREP, RERR, and Hello packets. Although both PGP and EDRP induce an extra overhead of Hello packets, they also significantly reduce the number of RREQ packets.

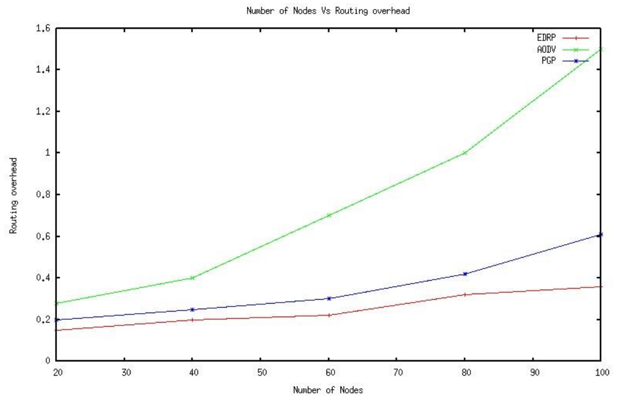

Fig. 2. Normalized routing overhead. It is find the how much overhad produced in mobilty.

Thus, they can reduce the normalized routing overhead. On average, the routing overhead is reduced by about 56.3% in the EDRP when compared with that of the conventional AODV. Under the same network conditions, the PGP also can reduce the routing overhead by 35.6% when compared with that of the AODV. Fig. 3 shows the packet delivery ratio of all the protocols for varying number of nodes in a fixed network area. The result shows that both the PGP and EDRP have a negative effect when the node distribution is sparse. When the number of nodes is less than 75, the EDRP has a lower packet delivery ratio than the conventional AODV. The reason is that when the node distribution is sparse, the situation that there is a hole in the network is more common. In addition, in our implementation, we do not process the *dead ends* problem, which induces a negative effect. As the node density increases, when the number of nodes is greater than 100 (about 62 nodes per square kilometer), the packet delivery ratio of the EDRP is greater than for the AODV, and it can reach about 95%.

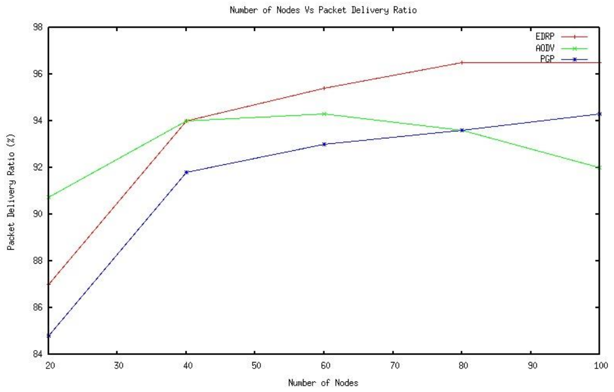

Fig. 3.Packet delivery ratio. All the protocols for varying number of nodes in a fixed network area.

Fig. 4. shows the average end-to-end delay of CBR packets that have been received at the destinations in different node densities. The end-to-end delay shows a similar trend to the packet delivery ratio in the sense that when the node distribution is sparse, the EDRP has poor performance than the AODV, and so does the PGP. However, there is a slight difference. When the number of nodes is greater than 125 (about 78 nodes per square kilometer), the EDRP has a lower delay than the AODV.

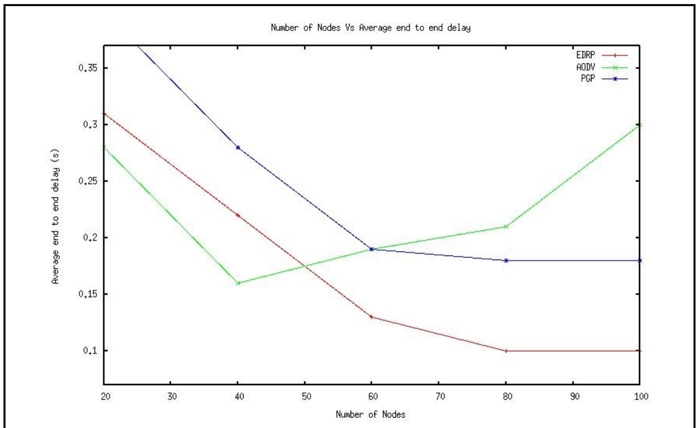

Fig. 4. Average end to end delay. It is find the how much overhad produced in mobilty.

4.1 Performance Evaluation

After analyzing the protocol, we evaluate the performance of the EDRP for varying mobile speeds. In mobile scenarios, the node speed is an important metric that affects the network topology. In this section, we fix the number of nodes to 150 (about 94 nodes per square kilometer) and vary the maximum speed from 5 to 25m/s.

The normalized routing overhead is shown in Fig. 5. In the calculation of the EGD, each node needs Hello packets to advertise its existence and sense the existence of other nodes. Therefore, the EDRP protocol incurs the overhead of Hello packets, and so does the PGP protocol. To reduce the negative effect of Hello packets, we do not use a periodical Hello mechanism. In our implementation of EDRP and PGP, only when the time elapsed from the last broadcasting packet (RREQ, RERR, or some other broadcasting packets) is greater than the value of the Hello Interval does the node need to send a Hello packet. Even so, it increases the control overhead inevitably. However, the AODV can work very well by using link layer detection instead of using exchanges of hello messages to detect link failures. To preserve fairness, the routing overhead includes all of the routing packets: RREQ, RREP, RERR, and Hello packets. On average, the overhead is reduced by about 57.0% in the EDRP when compared with that of the conventional AODV.

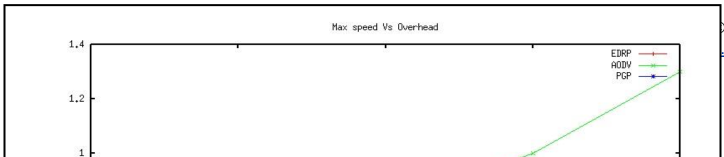

Fig.6. shows the packet delivery ratio of all three protocols. It decreases as the maximum speed increases because the network becomes less stable. In this node density, although the proposed EDRP protocol restricts the RREQ propagation range , it does not incur a negative impact. On the contrary, the EDRP improves the packet delivery ratio since it greatly enhances the stability of the routing path. In addition, the EDRP reduces the number of RREQ packets, which helps decrease the probability of packet collisions and increase the packet delivery ratio. On average, the packet delivery ratio is improved by 3.2% in the EDRP when compared with the conventional AODV. In addition, in the same situation, our approach improves the packet delivery ratio by about 2.1% when compared with the PGP.

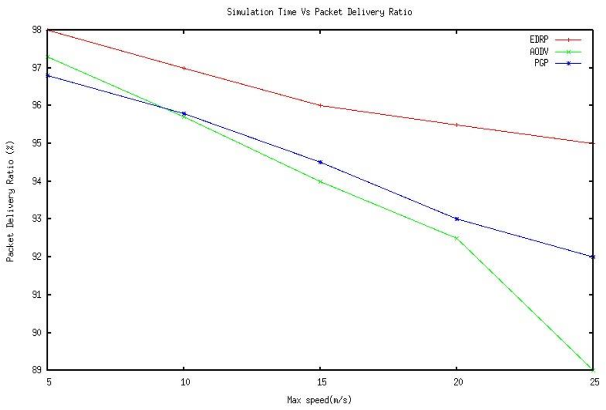

Fig. 6. Packet delivery **ratio**. It is find the maximum speed with packet ratio.

Fig.7. shows the average end-to-end delay of CBR packets that have been received at the destinations. When the speed increases, the frequency of link breakage increases. The frequent route reconstructions incur more routing control overhead so as to increase the probability of packet collisions and channel contention. Then, the end-to-end delay increases as the speed

increases. First, the EDRP can alleviate the collision and contention problem by decreasing the routing control traffic. Next, the EDRP can avoid weak paths that result in many re transmissions. Therefore, the EDRP also performs better in terms of end-to-end delay. On average, the end-to-end delay is reduced by about 37.2% in the EDRP when compared with that of the conventional AODV. Under the same network conditions, the delay decreases by about 24.5% when the EDRP is compared with that of the PGP.

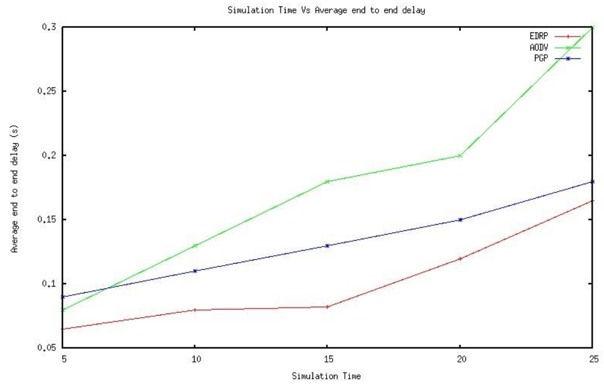

Fig. 7. Average end-to-end delay. It is find the how much of delay is calcutate with during time period.

5 CONCLUSION

I have to propose EDRP to reduced the routing overhead and RREQ packet. The estimated distance of the EGD and ETD.EGD has used to the estimated the future distance the next node and calculate the transmission range of another node. Then will find out the Link Quality (LQ) of the two nodes. Thus the protocol has find out the ETD to hop distance of the previous route to distance pair of between nodes. This protocol can estimate the distance of two nodes more accurately without positioning service to more efficiently steer the RREQ packet to the destination node and avoid RREQ packet to the entire network. AODV and PGP protocol will use to packet delivery ratio and the average end-to- end delay give some negative effect when the node distribution is very less. In future work added in security in the mobility nodes and find out minimum path distance.

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