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Performance comparison of Dynamic Source Routing with Weight Based Reliable Routing method

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ABSTRACT
Mobile ad hoc networks (MANET) are infrastructure less networks. The network topology may change rapidly because of high mobile nodes. Link failures are common because of the same reason. In this paper, Weight-Based Reliable Routing Method for MANETs is proposed. This method includes features that improve routing reliability, defined as the ability to increase packet delivery rate and throughput and uses the weight-based route strategy to select a stable route. Some parameter are assumed, like Node Remaining Energy, Route Expiration Time, No of Errors and No of Hops. Experimental results shows that the proposed WBRR performs better than DSR in the high mobility environment. Finally ensuring security in the weight based reliable routing method.

***Keywords*- AODV, DSR, MANET, RREQ, WBRR**

I. INTRODUCTION

A wireless ad hoc network is a dynamic network consisted of a group of mobile device in which communicate with each other by wireless media. Communication can be done when a node is in the wireless transmission region of another node. A source can send data to a destination which is not in its communication region through a group of nodes that willing to forward its packets. The determination of which nodes forward data is made dynamically based on the network connectivity. This is in contrast to wired networks in which routers perform the task of routing .It is also in contrast to managed wireless networks, in which a special node known as an access point manages communication among other nodes [1].

The other type of mobile wireless network is then on-infrastructure network commonly known as Mobile Ad hoc Network (MANET). Mobile ad hoc networks are a heterogeneous mix of different wireless and mobile devices, ranging from little hand-held devices to laptops. Such devices rely on on-board batteries for energy supply; hence energy efficiency of mobiles is an important issue[2]. Examples of MANET's applications are communication in remote or hostile environments, management of emergencies, and disaster recovery. Given the limited range of wireless communication, the network is generally multi hop, since direct communication between mobiles is generally not available. For this reason, a distributed routing protocol is required in order to provide communication between arbitrary pairs of nodes.

A major problem arises from the mobility of nodes causing the network topology to be variable and to some extent unpredictable. In fact, linkage break probability of nodes will be high, when stability of routing path is not considered. Best criteria's that are used for reliability in routing are:

• Route Expiration Time
• Node Remaining Energy
• No of Errors
• No of Hops

These criteria gives weight of the path. Procedures of path discovery usually find several path from source node to destination node then select path with maximum weight path as optimal path.

In this paper, it is aimed at how to enhance the stability of the network. A weight-based on demand reliable routing method (WBRR) is proposed to achieve this objective. The proposed scheme uses the weight-based route strategy to select a reliable route in order to enhance system performance.

II.RELATED WORK

In recent years, many routing protocols have been proposed for MANETs. Key routing protocols in MANETs is first reviewed in three broad categories: proactive routing protocols, reactive routing protocols, and location based routing protocols [2].

The proactive routing protocols maintain routing information independently of need for communication. The Update messages send throughout the network periodically or when network topology changes. It continuously try to maintain up-to-date routing information on every node in the network. It has Low latency which is suitable for real-time traffic. In proactive routing protocols bandwidth might get wasted due to periodic updates[3]. There are many proactive routing protocols, such as destination sequenced distance vector DSDV) ,wireless routing protocol (WRP) , cluster head gateway switch routing (CGSR), fisheye state routing (FSR) ,and optimized link state routing (OLSR) .

The reactive routing protocols determine route if and when needed. The Source initiates route discovery. The source node will issue a search packet and transmit the packet using the flooding technique to look for the destination node. This flooding technique will consume a large amount of time because of many redundant retransmissions. Hence significant delay might occur as a result of route discovery[3]. There are also many reactive routing protocols, such as ad hoc on-demand distance vector (AODV) , dynamic source routing (DSR) ,temporally order routing algorithm (TORA) , associativity-based routing (ABR) ,signal stability-based adaptive (SSA) and relative distance micro discovery ad hoc routing (RDMAR).

The location-based protocols, utilize the location information of sensor nodes to achieve scalability [21] in large-scale sensor networks. Location service systems also justify the use of these location-based routing protocols. Among them, stateless routing protocols do not require a node to memorize past traffic/paths, thus maintain almost no state information. These protocols that have been proposed are based on a geographic model[3]. Recent examples of this approach are GPS zone routing protocol (GZRP), location-aided routing (LAR), fully location-aware routing protocol (GRID), and zone-based hierarchical link state (ZHLS).

In this section, DSR is introduced, most general on-demand routing protocols . DSR is an on-demand routing protocol based on source routing. The Dynamic Source Routing protocol (DSR) is a simple and efficient routing protocol designed specifically for use in multi-hop wireless ad hoc networks of mobile nodes. DSR allows the network to be completely self-organizing and self-configuring, without the need for any existing network infrastructure or administration[4]. An important criterion in this algorithm is shortest path between source and destination. In the other hand minimum number of Hop between source and destination is important. Although shortest path may be have minimum durability[5].

III.ROUTE DISCOVERY

1. Dynamic Source Routing

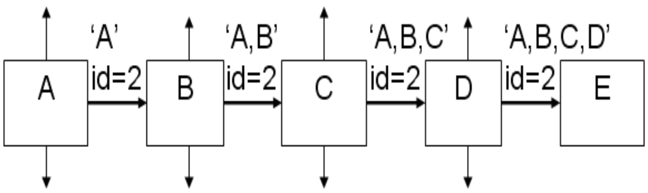

Fig 1. Route discovery

Node A (initiator) sends a Route Request packet by flooding the network. If node B has recently seen another RouteRequest from the same target or if the address of node B is already listed in the Route Record, Then node B discards the request. If node B is the target of the Route Discovery, it returns a RouteReply to the initiator. The RouteReply contains a list of the "best" path from the initiator to the target. When the initiator receives this RouteReply, it caches this route in its Route Cache for use in sending subsequent packets to this destination. Otherwise node B isn't the target and it forwards the Route Request to his neighbors (except to the initiator). In DSR every node is responsible for confirming that the next hop in the Source Route receives the packet. Also each packet is only forwarded once by a node (hop-by-hop routing). If a packet can't be received by a node, it is retransmitted up to some maximum number of times until a confirmation is received from the next hop[6].

Only if retransmission results then in a failure, a RouteError message is sent to the initiator that can remove that Source Route from its Route Cache. So the initiator can check his Route Cache for another route to the target. If there is no route in the cache, a RouteRequest packet is broadcasted.

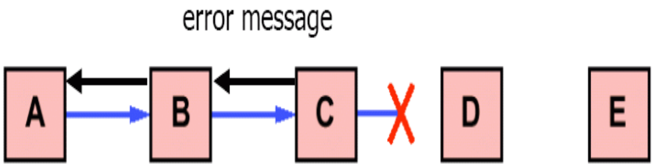

Fig 2. Route maintenence

If node C does not receive an acknowledgement from node D after some number of requests, it returns a RouteError to the initiator A. As soon as node receives the RouteError message, it deletes the broken-link-route from its cache. If A has another route to E, it sends the packet immediately using this new route. Otherwise the initiator A is starting the Route Discovery process again.

2. Weight-Based Reliable Routing Method

The proposed WBRR is an on-demand routing protocol and the route discovery process is similar to that of the DSR. However, WBRR, when a source node wants to select path to destination it first calculates the required energy (REQ) for the packets to be sent, then searches for an available path to the destination node from its own node information table. If the source node does not have an available path that can meet the energy constraint with maximum RET, minimum HC and EC, in this case it put REQe (minimum energy that nodes needed for sending whole of file) in route request packet and then initiates a route discovery procedure by sending the RREQ message to its neighbor nodes. If remaining energy of intermediate node is greater than requested energy for sending of file or data then the node automatically is selected and calculate LET and EC of a link if value of Calculated LET is smaller than value of pervious link then it is replaced in RREQ packet else it uses pervious LET. Then intermediate node that has all condition broadcast packets to its neighborhoods. Reversely if the remaining energy of node is smaller than requested energy for sending data in RREQ packet, then intermediate node, discard the packet and do not send it to neighborhood nods.

Therefore it prevent from broadcasting of discovery path from this node to its neighbors.

With considering this condition, intermediate node sends route discovery packet along the reverse path to the source node. Otherwise, the node increments the hop count by one and rebroadcasts the route discovery packet. Note that a node may receive multiple copies of the same RREQ packet from various neighboring nodes. When an intermediate node receives a RREQ packet with the same source ID and routing list ID, it discards the redundant RREQ packet and does not rebroadcast it. When the destination node finds a suitable path, it sends back a RREP packet to the source node[7].

When a node receive a RREQ message if it has enough remaining energy for supporting resource after calculating and changing broadcast packet to it's neighbors. This procedure is continued until RREQ packet find destination node. In other on demand routing algorithm route discovery packet is passed from all neighborhoods but in our method rout discovery packet is passed only from neighborhood nodes which have enough energy for supporting resource, therefore it prevent flooding of unnecessary packet like DSR which increase the consuming of energy.

By the time a broadcast packet arrives at a node that can supply a route to the destination node, a reverse path has been established to the source node of the route request. As the RREP packet travels back to the source node, each node along the path sets up a forward pointer to the node from which the route reply came, updates its timeout information for route entries to the source node and the destination node, and records the latest destination sequence number for the requested destination node[8].

IV.ROUTE SELECTION

In this section, the factors of the weight function is defined. Then the weight function of proposed method is introduced.

1. The Factors of the Weight Function

The weight function includes four factors: the route expiration time, residue energy of node, error count and hop count. The four factors are described as below;

1.1. Route Expiration Time (RET)

The RET is the minimum of the set of link validation times (LETs) for the feasible path. The LET represents the duration of time between two nodes. So first we obtain minimum value of LET in each path and then select the maximum number of RET witch represents the more reliable routing path.

RET=Min{LET}

The LET can be obtained by the principle that two neighbours in motion will be able to predict future disconnection time. Such a prediction can be accomplished by the following method[9]. The motion parameters of two neighbouring nodes can be obtained by using global positioning system (GPS). A free space propagation model is designed[9] in which the signal strength solely depends on the distance to the transmitter. It is assumed that all nodes have their clocks synchronized by using the GPS clock. If the motion parameters of two nodes are known, then the duration of time for which these two nodes remained connected is calculated. These parameters include speed, direction, and radio range and can be obtained from GPS.

For the sake of simplicity, we assume that nodes n1 and n2 have equal transmission radius r and that they are initially within hearing range. Let (x, y) and (x, y) denote the (x, y) position for node n and n , respectively. Also, let vi and vj denote their speeds along the directions q1 and q2 respectively. Then the duration of time between n1 and n2 is given by the following equation:

$$D_t = \frac{-(ab+cd)+\sqrt{(a^2+c^2)r^2-(ad-cd)^2}}{(a^2+c^2)}$$

$$a = v_1\cos\theta_1 - v_2\cos\theta_2 \qquad b = x_1 - x_2$$

$$c = v_1\sin\theta_1 - v_2\sin\theta_2 \qquad d = y_1 - y_2$$

The LET between two nodes in the feasible path by the Equation (2) is obtained. Then the RET is equal to the minimum value between set of LETs for the feasible path.

1.2. Node Remaining Energy

In this parameter, the total energy required to transfer the entire file is calculated, and it is named as requested energy. All data packets are send through the path which has the requested energy. In reliable path selecting, must consider the estimation of total energy for sending all of packet.

When a mobile node performs power control during packet transmission, the transmitting energy for one packet relative to the node distance is given as:

$$E_{tx} = Kd^{\alpha}$$

Where k is the proportionality constant, d is the distance between the two neighbouring nodes, and á is a parameter that depends on the physical environment (generally between 2 and 4).

The shorter distance between the transmitter and the receiver, the smaller amount of energy required. At each node, the total required energy is given by

$$REQ_e = n \times (E_{tx} + E_{Proc})$$

Where n is the number of packets. The energy required for packet processing (E) is much smaller than that required for packet transmitting. There is an Energy field (ECD) in RREQ packet that shows needed data transfer energy. Each node which receive RREQ packet, compare value of its own REQ value in own table with packet ECD, then two cases occur::

1. If ECD >= REQ and the node is not destination node then it broadcast packet to all.
2. It does not pass RREQ and drop it.

1.3.No of Errors(EC)

The error count is used to indicate the number of link failures caused by a mobile node. When an intermediate node receives a RREQ packet, it compares the error count in the route record of the packet with the error count in its route cache, and assigns the larger one as the new error count in the packet. The process continues until the RREQ packet reaches the destination node. The destination node eventually takes record of the error count values along all feasible routes. The smaller EC represents the more reliable routing path.

1.4.No of Hops(HC)

If each intermediate host has a larger roaming area, and the MANET has many nodes (and hops), then a feasible path with less hop is the preferred choice. The smaller HC presents the more reliable and less cost of routing path.

2. Route weight function

An algorithm which effectively combines all the four parameters with certain weighing factor C1, C2, C3 & C4 were proposed .Larger Route Expiration time(RET) and node energy(ECD) represents higher reliability and so do lower error count and lower hop count. The weight function is defined as an empirical mean value, where first normalization of each item is done and then combination of these four quantities is performed. More precisely:

$$W_i = C_1 \times (\frac{RET_i}{MaxRET}) + C_2 \times (\frac{ECD_i}{MaxECD}) + C_3 \times (\frac{EC_i}{MaxEC}) + C_4 \times (\frac{HC_i}{MaxHC})$$

C1 , C2, C3 ,C4 are the values which can be chosen according to the system needs. For example, route expiration time is very important in MANETs, thus the weight of C1 factor can be made larger[10].

The flexibility of changing the factors helps to select routing path.

$$|C_1| + |C_2| + |C_3| + |C_4| = 1$$

V. EXPERIMENTAL RESULTS

1. Route Expiration Time

PATH	RET
I	22.2349
II	18.0202
III	32.222
IV	11.6574

Third path is having maximum RET and hence it is the feasible path.

2. Node Remaining Energy

PATH	ECD
I	889573
II	1.35E+06
III	6.17E+06
IV	4.89E+06

Third path is having maximum ECD and hence it is the feasible path.

3. No of Errors

PATH	EC
I	1.25
II	1
III	0.8
IV	1.6

Third path is having minimum EC and hence it is the feasible path.

4. No of Hops

First path is having minimum number of nodes and hence it is the feasible path.

In this section, the performance of the proposed WBRR with DSR is compared. First some assumptions on the parameters of the system architecture in the simulations are made. The simulation modelled a network with 12 nodes.

The radio transmission range was assumed to be 250 m. The speed of each mobile node was assumed to be 15 m/s. The random waypoint mobility model was employed. Each node randomly selects a position and moves toward that location with a speed between the minimum and the maximum speed. Once it arrives at that position, it stays for a predefined time e.g. 2 second (pause time). After that time, it re-selects a new position and repeats the process.

Simulation shows the packet delivery ratio, throughput and packet loss of proposed method and DSR with different mobility speeds.

5.Packet Delivery Rate

The packet delivery ratio is the ratio of the number of data packets received by the destination to the number of data packets transmitted by the corresponding source. It is observed that proposed method transmits and receives more data packets than DSR .

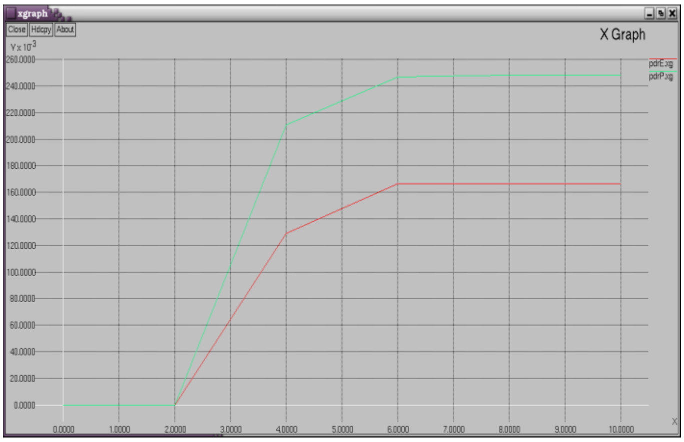

Fig 3: Packet Delivery Rate

The packets have been transmitting for ten seconds which can be seen from the figure 3. The x axis indicates the duration of time taken for transmitting the packets in which it takes two seconds to send hello packets and check whether the nodes in a particular range and from third second onwards the transmission starts and it ends by tenth second. The y axis indicates PDR.

6. Packets Throughput

The number of packets successfully received by the destination node.

Fig 4: Packets throughput

The packets have been transmitting for ten seconds which can be seen from the figure 4. The x axis indicates the duration of time taken for transmitting the packets in which it takes two seconds to send hello packets and check whether the nodes in a particular range and from third second onwards the transmission starts and it ends by tenth second. The y axis indicates throughput. It is clear from the above graph that the proposed WBRR is better than the existing method.

7.Number of packet drop

The total number of packets dropped while transmitting the packets from source node to destination node.

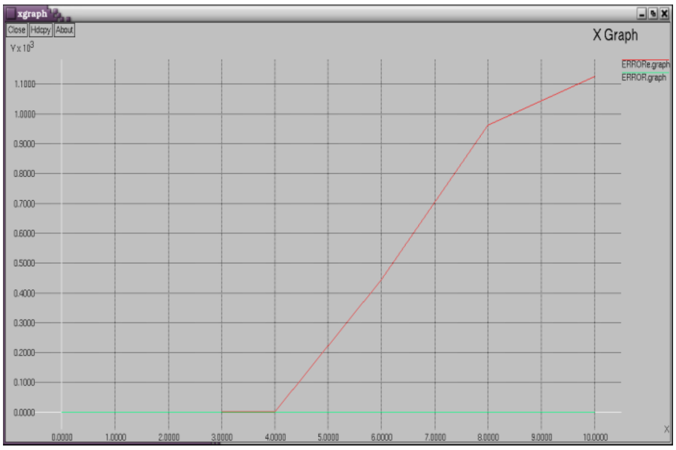

Fig 5: Packets drop error

The graph shows the dropping of packets while transmitting the packets from source node to destination node. The packets have been transmitting for ten seconds which can be seen from the figure 5. The x axis indicates the duration of time taken for transmitting the packets in which it takes two seconds to send hello packets and check whether the nodes in a particular range and from third second onwards the transmission starts and it ends by tenth second. The y axis indicates the number of packets. It is clear from the above graph that the proposed WBRR is better than the existing method.

VI. ACKNOWLEDGEMENT

The third path is the feasible path using reliable routing method and hence the next aim is to ensure security over that path. To ensure whether the path is still alive and transmissions are taking place, it is necessary to send acknowledgement. Ensuring security is done by transmitting a set of packets from source node to the destination node and the destination node in turn should reply the source node by means of an acknowledgement packet. The retrieval of the acknowledgment packet by the source node make sure that the feasible path is completely secure for transmitting the data.

Fig.6 shows that the third path is the feasible path, after substituting the results of all the four factors in the weight function and here by sending acknowledgement from destination to source, we have sent acknowledgement over that path.

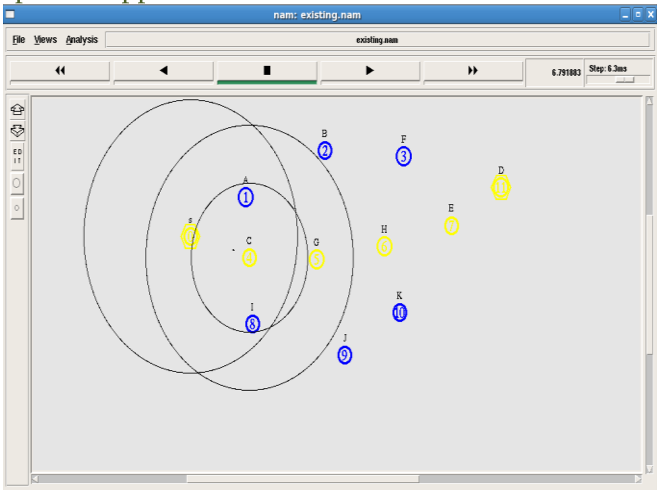

Fig 6: Acknowledgement

VII. CONCLUSION

In this paper, a routing algorithm with high stability is proposed, this method maximizes the weight among the feasible path in order to select a stable routing path. The route selection is based on the weight value of each feasible path. In a feasible path, the high weight value represents good reliability. It also represents higher mobility of each node in the path. It also represents that the feasible path is secured. The results shows that in the high mobility environment the proposed WBRR method outperforms DSR and also the security has been ensured for the feasible path.

Research on new simulation environments similar to ns2 could also be done, resulting in the development of new features such as more detailed graphs. In addition to this, improving packet delivery efficiency is the challenging area to be explored more. Moreover, due to the dynamically changing topology and infrastructure less property, secure and power aware routing is hard to achieve in mobile adhoc networks. An attempt will be made to cope up these issues in our future research work by proposing a solution for secure and power aware routing. Ad-hoc networks are highly vulnerable to security attacks and dealing with this is one of the main challenges of developers of these networks today.

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