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A Reinforcement Learning Network Based Novel Adaptive Routing Algorithm for Wireless Ad-Hoc Network

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Abstract— Mobile communication has enjoyed an incredible rise in quality throughout the last decade. Network dependability is most important concern in wireless Ad-hoc network. a serious challenge that lies in MANET (Mobile Ad-hoc network) is that the unlimited mobility and lots of frequent failure because of link breakage. Standard routing algorithms are insufficient for Ad-hoc networks. as a results of major drawback in MANET is limited power provide, dynamic networking. In MANET each node works as a router and autonomously performs mobile practicality. The link connectivity changes ceaselessly because of mobility to reflect this routing information additionally needs to get changed ceaselessly. AODV protocol is projected for this extraordinarily mobile network. In ancient AODV if any node fails in middle of transmission the method starts from the source node but in our propose scheme the transmission starts from the closest neighbor node therefore shows very important reduction in delay and improvement in packet delivery ratio are achieved. It also reduces the routing overhead by reducing the frequency of route discovery process.

Key words: MANET, Wireless, Routing Protocol, AODV, DSR, ZRP

I. Introduction

A mobile ad hoc network (MANET) is a collection of mobile devices that are connected by wireless links while not the utilization of any fixed infrastructures or centralized access points. In MANET, every node acts not only as a host however also as a router to forward messages for different nodes that don't seem to be among the same direct wireless transmission range[1]. Every device in a very MANET is free to move independently in any direction, and can thus modification its links to different devices frequently. MANETs are much more vulnerable and are susceptible to numerous kinds of security attacks [2].

These nodes have routing capabilities which permit them to make multihop paths connecting node that aren't within radio range. The routing protocols are roughly divided into three categories: proactive (table driven routing protocols), reactive (on- demand routing protocols), and hybrid. The first goal of such an ad hoc network routing protocol is to supply correct and efficient route establishment between pair of nodes, in order that messages could also be delivered in time. In proactive, every node maintains a routing table, containing routing data on reaching each different node within the network. In reactive, once a node wishes to send packet to a selected destination, it initiates the route discovery process, in order to find the destination [3].

Proactive protocols are known as table driven protocols like DSDV and OLSR during which, every node maintains the routing information of all nodes in routing table. This type of protocol is appropriate for limited number of nodes. in contrast to proactive protocols, reactive protocols are known as on demand protocols like AODV, DSR [7] and establish the route to the destination whenever communication is required. Hybrid protocols like ZRP are the combination of proactive and reactive protocols.

Ad-Hoc On demand Distance Vector Routing protocol (AODV) is wide used for the route discovery within the MANET. The AODV routing protocol comes beneath the class of reactive routing protocol, which means that it discover the route after receiving the Route Request (RREQ) from the source node [4]. AODV doesn't permit keeping additional routing that isn't in use [5]. There are three AODV messages i.e. Route Request (RREQs), Route Replies (RREPs), and Route Errors (RERRs) [6].

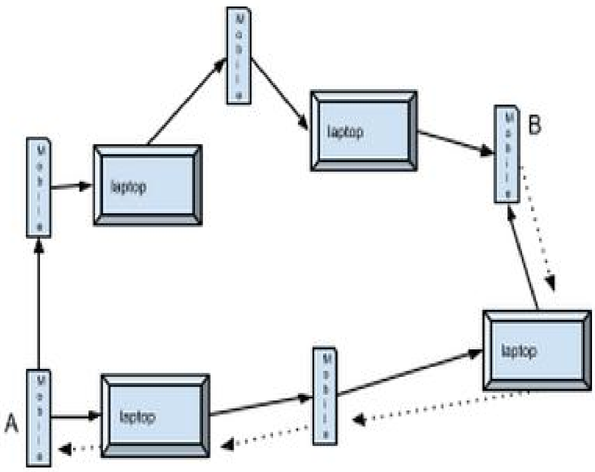

Fig. 1: RREQ and RREP messages in MANET using AODV

When the source node needs to make a new route to the destination, the requesting node broadcast an RREQ message within the network [8]. in the figure one the RREQ message is broadcasted from source node A to the destination node B. The RREQ message is shown by the black line from source node A to several directions. The source node A broadcasts the RREQ message within the neighbor nodes [9]. Once the neighbor nodes receive the RREQ message it creates a reverse route to the source node A. This neighbor node is that the next hop to the source node A. The hop count of the RREQ is incremented by one. The neighbor node can check if it's an active route to the destination or not. If it's a route, then it'll forward a RREP to the source node A. If it doesn't have an active route to the destination, then it'll broadcast the RREQ message within the network once more with an incremented hop count value. The figure one shows the procedure for locating the destination node B [9]. The RREQ message is flooded within the network in searching for finding the destination node B. The intermediate nodes can reply to the RREQ message only if they have the destination sequence number (DSN) adequate to or larger than the number contained within the packet header of RREQ [10].

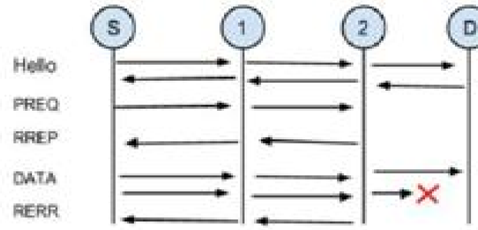

Fig. 2: Working of AODV protocol

Neighboring nodes sporadically exchange hello message, Absence of hello message is used as a sign of link failure.

II. Comparison of Routing Protocol

PARAMETER	DSR	AODV	TORA
Route computation	On-demand	On-demand	On demand/Proactive
Routing structure	Flat	Flat	Flat
Routes maintained	Route cache	Route table	Route table
Source routing	Yes	No	No
Hello messages	No hello message	Small size, used as a supplement for neighbour detection	LMR messages to query about neighbours and heights
Update information & Route maintenance	Route error	Route error	Nodes height
Multicast \capability	No	Yes	No
Routing metric	Shortest path	Freshest and shortest path	Shortest path
Loop free	Yes, Source route	Yes, Sequence number	Yes

Table 1: Comparison of Protocol

III. AODV Basics and Related Work

Reactive protocols establish the route once source has data send to destination. Examples for Reactive protocols are AODV and DSR routing protocol. During this paper, our work is to enhance performance of AODV routing protocol. During this section, we'll see the function of AODV routing protocol and literature survey of various routing protocols that optimizes the performance of AODV. AODV (Ad hoc On demand Distance Vector) Routing Protocol was proposed [8] and it's designed for nodes that are in mobile fashion to line up an ad hoc Network. As a reactive routing protocol, AODV protocol maintains the routing information of all destinations within the routing table

In AODV every node have latest information available about the sequence number for the IP address of destination node for which the route table entry is maintain, this sequence number call "destination sequence number"to enable Fresh route and to avoid loop free mechanism AODV use destination sequence numbers.AODV is hop by hop routing protocol that sends and receives data and maintain active route using Route Request (RREQ), Route Reply (RREP), Route Error (RERR) and HELLO message..

A node can change the sequence number in entry of routing table of destination when the node is destination node itself and offers new routes itself, or it receive the new information of sequence number of destination node or path of Destination node expire or break. A destination node can increments its own sequence number in two ways , when a node originate a route discovery or a destination node originate route reply in response to route request in this circumstances it must update its own sequence number to the maximum of current sequence number and destination sequence number in RREQ packet.

A. RREQ:

Figure 3: Route Request Frame Format

In Route Discovery phase source node want to send data to destination node but if it not have route to destination it broadcast the RREQ with incrementing the broadcasting id and destination sequence number. Intermediate node receives RREQ and send RREP if it has active route available for destination otherwise it broadcast again RREQ. Route request packet travels entire in network, intermediate node receive the packet and add node address in routing table from which it has received for reversed route if it does not has route. Intermediate node or destination node can send a RREP. If intermediate node has route to destination then it generate RREP and send it to source node using reverse route with new sequence number in a unicast manner.

B. RREP:

Source Address	Destination Address	Destination Sequence Number	Hop Count	Life Time

Fig. 4: Route Reply Frame Format

After receiving a route reply, an intermediate node establish forward route to destination. If intermediate node has an active route to the destination, the destination sequence number within the node's existing route table entry for the destination is valid and bigger than or equal to the Destination Sequence number of the RREQ. The intermediate node additionally updates its route table entry for the node originating the RREQ by inserting the next hop towards the destination for the reverse route entry. If the destination node sends RREP, it must increment its own sequence number by one if the sequence number within the RREQ packet is equal to that incremented value. The destination node places its sequence number into the

Destination Sequence number field of the RREP, and enters the value zero within the Hop Count field of the RREP. If destination generates RREP, the intermediate nodes within the route update their routing tables whenever they receive RREQ and RREP. The source node sends the info after it receives RREP.

C. RERR:

RERR

<table>
<tr><td colspan="10">0</td><td colspan="10">1</td><td colspan="10">2</td><td colspan="2">3</td></tr>
<tr><td>0</td><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td><td>7</td><td>8</td><td>9</td><td>0</td><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td><td>7</td><td>8</td><td>9</td><td>0</td><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td><td>7</td><td>8</td><td>9</td><td>0</td><td>1</td></tr>
<tr><td colspan="8">Type</td><td>N</td><td colspan="15">Reserved</td><td colspan="8">Dest Count</td></tr>
<tr><td colspan="32">Unreachable Destination IP Address (1)</td></tr>
<tr><td colspan="32">Unreachable Destination Sequence Number(1)</td></tr>
<tr><td colspan="32">Additional Unreachable Destination IP Address (if needed)</td></tr>
<tr><td colspan="32">Additional Unreachable Destination Sequence Number (if needed)</td></tr>
</table>

Fig. 5: Route Error message format

In Route maintenance phase, all the nodes broadcast messages to tell the status of route. each node broadcasts hello messages at specific intervals to its neighbors regarding its existence. If a node didn't receive hello message from its specific neighbor, then there may be a link break. once a link break is detected, the detecting node sends Route Error (RERR) messages to all of its predecessor nodes regarding the broken link. Then, the source node reinitiates the route discovery process to the destination for the data transfer.

S.Shanthini Devi and Dr. K.Thirunadana [8] proposed a scheme in which route error tolerance mechanism is improved to increase performance of MANET. Overall output is increase by handaling route error efficiently in this they propose that the node which previously forward packet handles the route failure so it reduce the source overhead in the transmission.

Shailja Gupta and Raj Kumar Paul [6] proposed a scheme in which every node contain two version of routing table current updated and previously updated routing table If link fails between an two intermediate node on basis of latest version of routing table then before sending a Route error (RRER) message to previously forwarded node, node checks its old version of routing table and if any path available for destination then it assume that path for transmission and node deletes the entry for that destination from latest version of routing table.

P. Manickam, and Dr. D. Manimegalai [15] proposed a new energy efficient routing protocol called AODV–EBR (AODV- Energy based routing) to handle the broken link of routes and efficiently deliver packet to destination. They proposed an algorithm if neighbor node's energy level is less then SEL then AODV-EBR activate the upstream node to start a new route discovery Once AODV-EBR discovers the new route, it permits the nodes to use the new route for sending data packets to the destination before the network is divided due to presence of weak nodes.

E.Ravindra,Vinaya Datt,V Kohir[24] projected a protocol that improves the performance of an on demand protocol by maintaining 2 tables at every node and check these tables periodically. every node maintains 2 tables NPL (Neighbor Power List) and PDT (Power difference Table). NPL contains the last received signal strength for packets originating from every neighbor.

Anil Choudhary, O.P. Roy and T.Tuithung [4] proposed a new node failure model during which it's design to look at the impact of node failure on the performance and reliability of network in this model the number of iteration is obtained by dividing total time with granularity. for every iteration the probability is calculated exploitation lambda (1/MTTF).The failure rate of system sometimes depends on time with the rate varying over the life cycle of the system. A random number is generated for every node in particular iteration A node is unsuccessful once random number generated is a smaller amount than the probability value.

IV. ENERGY CONSUMPTION MODEL

Mobile nodes are equipped with AN IEEE Network Interface Cards with 2Mbps. These values correspond to a 2,400 MHz WaveLAN implementation of IEEE 802.11.A wireless network interface will be anybody of the subsequent four states and consumes some amount of energy.

- Transmit: Node transmits a packet with transmission power Ptx.
- Receive: Node receives a packet with reception power Prx and a Node consumes same amount of power once it discards a packet.
- Idle: Node neither sends nor receives a packet with idle power Pidle and node listens wireless medium with this power.
- Sleep: Node is in sleeping state.

We may calculate the Energy consumed by node as multiplying power with time.

$$\text{Energy} = \text{Power} * \text{Time} \quad (1)$$

The Nodes consume their energy during the transmission (Etx) or reception (Erx) of a packet and it can be calculate using

$$Etx = Ptx * \text{duration} \ (2)$$
$$Erx = Prx * \text{duration} \ (3)$$

V. PROPOSED WORK

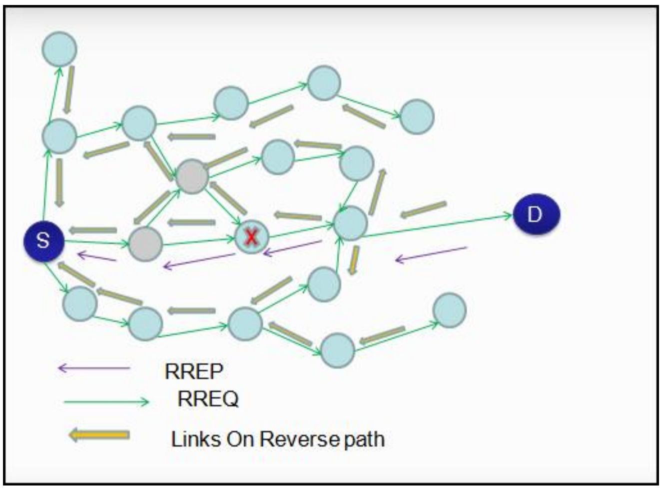

Fig. 6: Proposed method of AODV

AODV is source initiate protocol but in this when any link break the process starts from its source node , again broadcasting take place and then link established, after getting RREP the actual communication take place.

So in my propose work: If any node fails between source and destination then The Process starts from its nearest neighbor node. Neighbor have link to the source node which have already received RREP. So to find the destination process starts from its neighbor nodes. Neighbor broadcast RREQ and finding path to destination. So in this scheme when node fails at that time we do not have to go to source we can start process from the neighbor nodes.

Now if there are only 2 nodes in network then process is same but at this time source broadcast the RREQ because at that time nearest neighbor is source.

VI. CONCLUSION

It is observed that AODV protocol gives the better performance than the others. The performance depends on some factors like node speed, mobility and other scenarios. Our purpose scheme get batter handling when any node fails in between communication is ongoing. So it gets increase packet delivery ratio and Throughput of AODV Protocol.

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