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Design and Implementation of a Protocol in Mobile AD-HOC Network

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Abstract— MANET consists of many routing protocols. Ad-Hoc on Demand Vector routing protocol is one among them, which establishes the route only when required. In AODV protocol link breakages and rediscovery of routes are very often because of high mobility of nodes in the network. In Modified Ad-Hoc On Demand Vector (M-AODV) instead of establishing reverse path it broadcasts route reply back to the source which lower the rediscovery of routes, and hence the packet delivery ratio will therefore be increased when there are low link breakages.
Keywords— MANET Mobile Ad-Hoc Network, AODV Ad-Hoc On Demand Vector, M-AODV Modified Ad-Hoc On Demand Vector, RREP Route Reply, RREQ Route Request, PDR Packet Delivery Ratio etc.

I. INTRODUCTION

Wireless networks can be divided into two, infrastructure networks and Ad-Hoc networks as shown in figure 1. Infrastructure networks are centralized type of network. Where the base station acts as a coordinator in communication between two nodes. Whereas, in Ad-hoc networks, each node has transmitter and receiver built-in. So when two nodes want to communicate with each other can directly contact if both are in range of each other. And each node is allowed to move anywhere. Now suppose two nodes want to communicate and both are not in range of each other, then with the help of intermediate nodes two nodes can communicate.

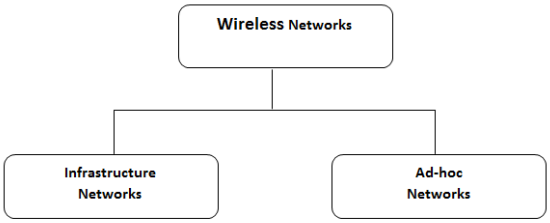


Fig. 1 Classification of wireless networks

AODV routing protocol is initiated by the source. When some data has to be sent, the source node first broadcasts the Route Request until it reaches the destination. Once the RREQ is reached to the destination. This destination node replies back the Route Reply packet to the source by reversing the direction of the same path by which RREQ is received. The source node after receiving RREP, it starts transmitting of packets. If any link breakages are occurred, the intermediate node notifies upstream by Route Error packet (RERR). Then that path is completely removed from the table. And a new path is rediscovered by the source node to transmit the packets.

II. MOTIVATION

In MANET, nodes move from one location to another depending upon the mobility model, varying speed and pause time. So the network should be capable enough to handle the changes of the topology. The communication link can be easily lost when the mobility is high. In on demand routing protocols, change in topology leads to link breakages and packet loss. Losing Route replying (RREP) AODV protocol leads to large degradation of performance [1]. Such as, loss of packets and hence packet delivery ratio is low due to loss of RREP packet. In Figure 2 Suppose S is the source node, D is the Destination node and rest nodes are intermediate nodes. Node S broadcasts Route Request until it reaches the destination. Once RREQ reaches the destination reverse path is built so that Route reply path is set. In the Figure 2 D->5 ->4 ->3 ->S is set to build RREP. And suppose Node 3 moves from its position to the direction as shown in the figure. RREP will be missing and re-discovery of RREQ should be done. So to overcome this problem, broadcast of route reply (RREP) is also done.

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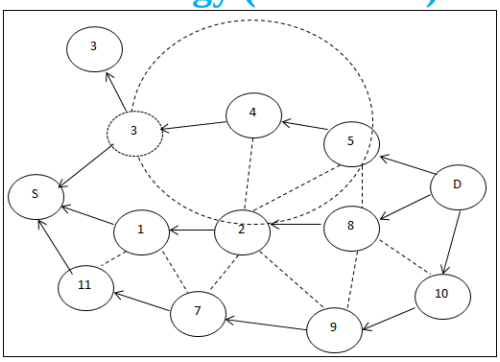


Fig. 2 Problem with AODV

III. PROPOSED PROTOCOL

In this section we present an overview and purpose of proposed new protocol.

A. Protocol Overview

As we have seen in the previous example, the high mobility leads to re discovery of routes by broadcasting of RREQ. So to overcome this, the broadcasting of RREP is done. The proposed new protocol broadcasts the route reply in AODV so that there are lower possibilities of broadcasting route requests i.e., re-discovery of path. So here, the destination broadcasts RREP until it reaches source. Once source receives RREP, it starts transmitting data packets to the destination.

B. Route Discovery In M-Aodv

Since M-AODV is on demand routing protocol there are no routes stored in the routing table. Broadcasting of RREQ is always done to find the path to the destination. And this is initiated by the source node. The RREQ message contains following information as shown in figure 3 message type, source address, destination address, broadcast ID, hop count, source sequence number, destination sequence number, request time.

Type	Reserved	HopCount
Destination IP address		
Destination Sequence Number		
Source IP address		
Life Time		

Fig 3 Packet format of AODV

Each time broadcast ID is incremented whenever a new RREQ is issued by source node. Thus RREQ is uniquely identified by its broadcast ID, source address and destination address. Initially source node broadcasts RREQ to the node which is in its own range. Once the neighboring nodes receive RREQ it rebroadcasts again until it reaches the destination. Whenever an intermediate node receives RREQ. It first checks whether it has already received the same RREQ i.e., with same broadcast ID and address of source and destination. If yes, then it discards otherwise it simply forwards the RREQ if the current node is not the destination. Once the RREQ reaches the destination, it broadcasts back the RREP the same way as RREQ was done. RREP format is as shown in figure 4. This also checks whether the RREP is repeatedly sent then discards.

Type	Reserved	Hop Count
Broadcast ID		
Destination IP address		
Destination Sequence Number		
Source IP address		
Reply Time		

Fig 4 Modified packet format

When the first RREP is received to the source, the source node starts transmitting packets to the destination. And further RREP are saved to use in future. When the current path is lost, the next path is chosen instead of rebroadcasting again. Traditionally, AODV protocol used to reverse link D->5->4->3->S. But in this modified protocol it does not unicast reverse path. As it broadcasts the RREP, the source will have more than one path. Even if any of the intermediate node moves for example in

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figure 5 node 3 moves away, the source selects alternative path to reach destination. The alternate path can be S->1->2->8->D and S->11->7->9->10->D. So packet delivery ratio is greater in modified protocol compared to the existing one, because it maintains stable routes by providing alternative routes compared to AODV protocol.

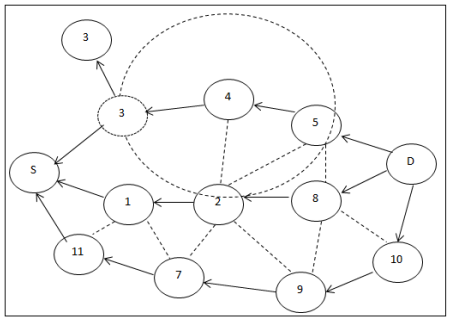


Fig 5 Solution for AODV

C. Route Update And Maintenance

The best path in the modified protocol is chosen based on its sequence number. Higher the sequence number latest is the route. And suppose now the sequence number is equal so now the hops are considered. Lesser number of hops is considered to be the shortest and best path. When a node notices that the downstream link of the respective node is out of its range, the node generates RERR to its upstream node.

D. Algorithm For Selection Of Path In M-Aodv

```
If SequenceNum(existing) < SequenceNum(new)
   Select new path
Else if SequenceNum(existing) == SequenceNum(new)
   If HopCount(existing) < HopCount(new)
            Select existing path
   Else
            Select new path
Else
   Select existing path
```

IV. PERFORMANCE RESULTS

The parameters used for simulation are shown in Table I.

TABLE I

Parameter	Value
Protocols	AODV, M-AODV
No of nodes	25
Traffic Type	CBR
Queue length	50
Pause Time	0, 50, 100, 500, 900.
Mobility Model	Random Way Point

Packet Delivery Ratio :

The number of packets received at the destination to the number of packets sent by the sources.

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$$Packet\ Delivery\ Ratio = \frac{Number\ of\ packets\ Recieved}{Number\ of\ packets\ sent} * 100$$

Random way point is a type of mobility model, where each node selects a velocity between [0,Vmax], and a random node and moves towards it. It waits for a period of time; this time is "pause time" and continues same.

A. Results

Packet Delivery Ratio is plotted AODV against M-AODV. For 0 pause time AODV works well. But when pause time increases M-AODV starts working better than AODV. So M-AODV works well when there is high mobility in the network. The Fig 6 illustrates the same.

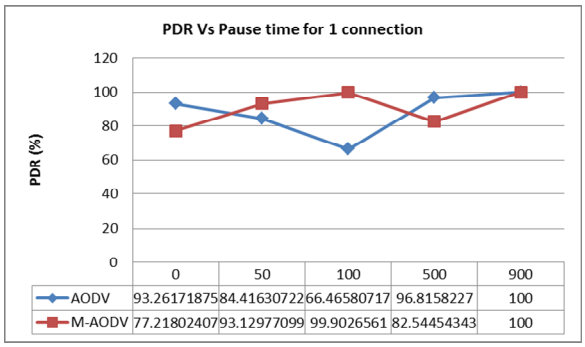


Fig 6 PDR Vs Pause Time for 1 connection

In Fig 7 with 5 connections M-AODV mainly concentrates on the link breakages. So when mobility is high it starts working better than AODV. For 50 pause time M-AODV outperforms AODV. Also with 100 pause time. When the connections are increased, even AODV works well for 0 pause time. And gradually decreases the performance when the pause time is increased.

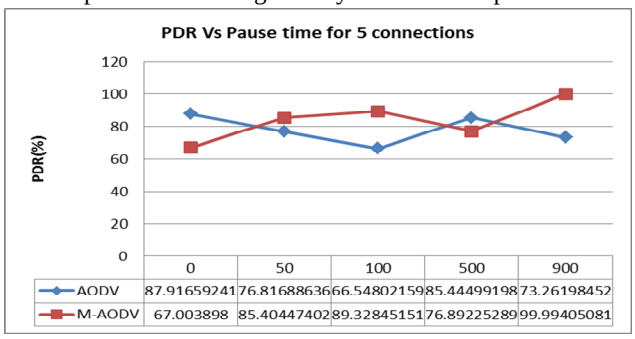


Fig 7 PDR Vs Pause Time for 5 connections

This is because link breakages occur only when mobility is high. And this type of protocol works well only when the mobility is high and also when the number of connections goes on increasing the Modified-AODV starts working really well. For 10 number of connections as shown in figure 8, AODV works well for 0 pause time but when the pause time is increased it degrades the performance compared to M-AODV. The reason is same the link breakage occurs when the mobility is high, and M-AODV starts working well when the mobility is high.

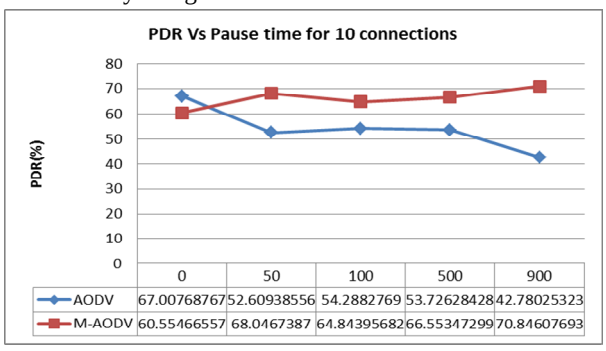


Fig 8 PDR Vs Pause Time for 10 connections

For 20 connections M-AODV works well than AODV as shown in Figure 9, because when mobility is high there will be

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increase in link breakages. And M-AODV handles the link breakages well. Therefore it works very well when the network is more mobile.

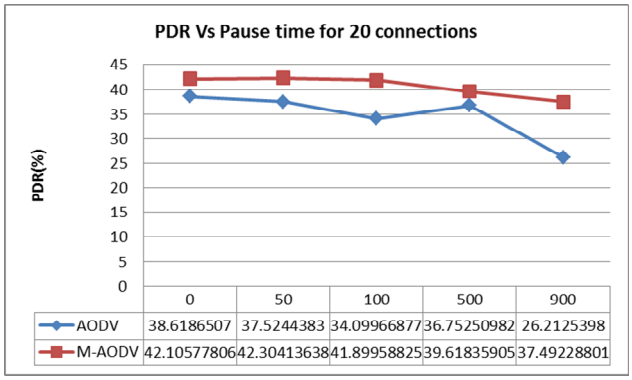


Fig 9 PDR Vs Pause Time for 20 connections

V. APPLICATIONS

Ad-Hoc networks are used in Tactical Networks such as Military communication and operations and Automated battlefields. Also it can be used ain Virtual Classrooms, Ad hoc communications during meetings and lectures and Universities and campus settings. Also used as search and rescue operations and disaster recovery. Also used in hospitals for emergency cases, this will be helpful for doctors and nurses to monitor the patient.

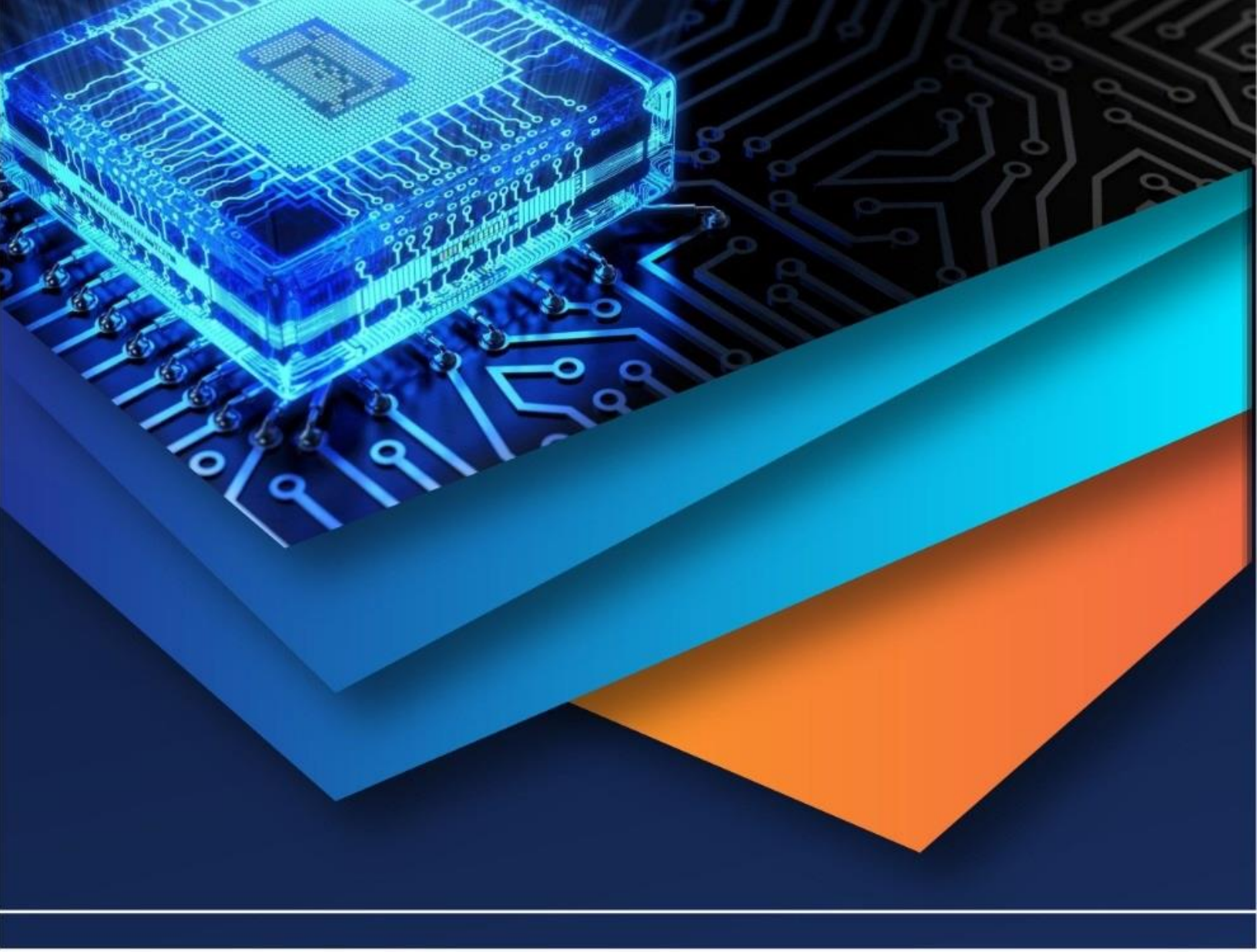
VI. CONCLUSIONS

The comparison of the AODV with M-AODV is done. The modified protocol works well when there is high mobility this is because, in normal AODV link breakages are very often this is because the nodes are so mobile that they can move anywhere and rediscovery of routes are very often. And to avoid this link breakages and rediscovery of paths M-AODV broadcasts RREP. And this leads to high packet delivery Ratio compared to the normal AODV

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