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Route Maintenance in AODV Routing Protocol: A Review

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Abstract *– Characteristic of wireless ad-hoc network is continuously varying in topology. Route between source to destination breaks due to change in topology. There are two methods of route maintenance after route break. One is route repair by source node. Another is route repair by local route repair technique. Here in this paper some different kind of local route repair techniques are describes.*

Keyword: AODV, Local route repair (LRR), Multipath, Route Request, Route Reply.

I. INTRODUCTION

Now a day's ad-hoc network [1] is very popular due to mobile and computer devices such as laptop and palmtops. These types of devices have minimum configuration, and also no need to create infrastructure to quick deployment, in emergency operations and especially for military operations. In ad-hoc network nodes are mobile. Mobile nodes are continuously moving and also frequent changes in topology. So, maintenance of Ad-hoc network is very difficult as compared to wired network. Sometimes it may possible that source node or destination node moved out of the network. Ad-hoc routing protocol [1] classified into Proactive and Reactive routing protocols. In proactive routing protocols exchange their periodic table at each node to get information of topology. Example DSDV, WRP.

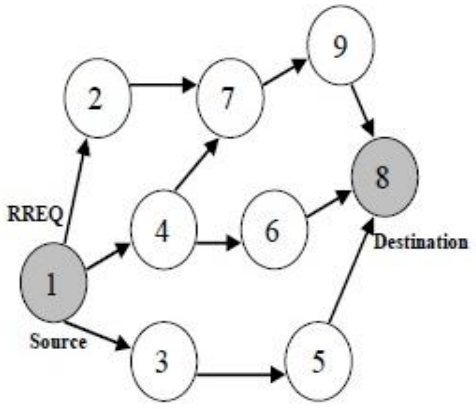
Reactive routing protocols [1] exchange routing table on-demand. When it establish route between source to destination. Reactive protocol likes DSR, AODV etc. Every protocol has its limitations on different metrics, but in general the reactive protocols show better performance than the proactive protocols.

II. AODV ROUTING PROTOCOL

AODV [2] protocol provides quick and efficient route establishment between nodes desiring communication and AODV was designed specifically for ad hoc wireless network, it provides communication between mobile nodes with minimal control overhead and minimal route acquisition latency.

A. AODV Route Discovery

When a node [2] wishes to send packet to destination node, it checks to route table to determine whether it has a current route to the node. If so, it forwards the packet to the suitable next hop toward the destination the destination. However, if the node does not have a route to the destination, it must begin a route discovery process. To start such a process, the node creates RREQ packet. This packet contains the source node's IP address and current sequence number as well as destination's IP address and last known sequence number. The RREQ has a broadcast ID, which is incremented every time the source node generates a RREQ. In this way broadcast ID and the IP address of the source node from a unique identifier for the RREQ. After generating the RREQ, the source node broadcasts RREQ and then sets a timer to wait for a reply.

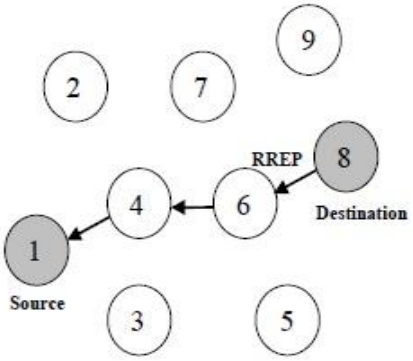


When a node receives a RREQ, it first checks whether it has seen before by observing the source IP address and broadcast ID pair. Each node maintains a record of the source IP address/broadcast ID for each RREQ it receives, for a definite length of time.

To respond to the RREQ, the node must have known the route to the destination in its route table. The sequence number of destination node must be indicated in the RREQ. This prevents the formation of routing loops by ensuring that the route returned is never old enough to point to a previous intermediate node. If the node is able to satisfy these two requirements, it responds by unicasting RREP back to the source.

B. Route Maintenance

Once a route has been discovered [2] from source to destination. Movement of nodes in the ad hoc network affects only the routes containing those nodes; such a path is called an active path. If the source node moves during data transmission process, it can restart route finding to build a new route, to the destination. When either the destination or some intermediate node moves, however, a Route Error (RERR) message is sent to the affected source nodes. This RERR is started by the node upstream of the break. It lists each of the destinations that are now unreachable because of the loss of the link. Broken node of route broadcasts the RERR to the neighbours. When the neighbours receive the RERR, they mark their route to the destination as invalid by setting the destination equal to infinity. When a source node receives the RERR, it can reinitiate route finding if the route is still needed.



There are two type of route maintenance. One of them is source route recovery is mentioned above that like source broadcast RREQ to its neighbour RREQ having source and destination IP address and broadcast ID and sequence numbers. When destination sends RREP it receives by source node through intermediate node. Second method is local route recovery using intermediate node. In this method broken link is recovered by intermediate node. Intermediate node broadcast RREQ to its neighbour and route request reach at destination. Destination gives reply with RREP and route is once again established between source to destination.

III. EXISTING TECHNIQUES

1. Multipath

In 2011, Jyoti Jain and Roopam Gupta [3] proposed that ORMAD (On-demand Route maintenance in Multipath AODV) tries to optimize routing overhead of both Route Discovery Process (RDP) and Route Maintenance Process (RMP) of multipath extensions to AODV. When detecting a link failure in the primary route, ORMAD invokes a local repair procedure between the upstream and the downstream nodes of the broken link. ORMAD applies RMP only to the efficient routes, which leads to enhance route efficiency and consequently minimizes routing overhead. Author shows that the performance is affected by varying the RREP waiting times of both phases RDP and RMP in different scenarios. ORMAD enhances routing packets overhead and average end-to-end delay compared to other protocols, especially in high mobility scenarios.

2. Static node in realistic mobility model

In 2011, Rakesh kumar, Siddharth Kumar, Sumit Pratap Pradhan and Varun Yadav [4] proposed that after the route discovery process, we traverse the path in order to find the static nodes in the route. These static nodes are consists of buffers to store the necessary information and packets. If the static nodes are found in the route, then a buffer is attached to each static node in order to store the information regarding the static nodes and the packets in case of link failure.

3. Alternate Backup route

In 2011, Aditya Dhatrak, Amruta Deshmukh and Rahul Dhadge [5] proposed that Robust AODV with Local Update, the route is built on demand and maintained by locally updating route information. Multiple back up routes are built around active route and the highest priority back up route will be switched to become new active route when the current active route is less preferred.

4. Parallel route recovery

In 2010, Amit D. Kothari and Dr. Ashok R. Patel [6] proposed that when packets do not reach the destination, to resolve this problem, the node which is affected by link failure generates a temporary parallel route request to the neighbouring nodes to reach the destination. A temporary parallel route request is broadcasted by the intermediate node. A timer should be fixed by the initiator to track the time to live for the packet in the network. Shortest and optimal hop count is necessary to transmit the data faster to the destination.

5. Enhancing Route Recovery for QAODV

In 2008, Nityananda Sarma, Sukumar Nandi And Rakesh Tripathi [7] proposed that sending RERR back to the source to re-initiate route discovery by the source, for route recovery due to link failure, gives large control overhead, packet loss and delay. For providing QoS support, we need an efficient and faster route recovery/maintenance mechanism. So in this proposed method each node in an active route remembers the node ID of the second downstream node and updates this information during local route recovery process. When a link of an active flow breaks, there still exists some neighbour of the upstream node through which the downstream node and/or the 2-hop downstream node of the broken link reachable with the single hop. In the case, the node detecting the link failure finds one such neighbour, it can repair the path very fast by adding an extra node in the repaired path very little amount of extra control overhead. In this method local route repair in QAODV, a number of control packet are used as follows. When detects link break it sends LRREQ (Local Route Repair Request) is used to locally broadcast. LRREP (Local Route Repair Reply) is used to reply LRREQ. If LRREP not received with in time period, Node sends RERR packet to source node follow the normal route recovery procedure.

6. ELRAODV (Enhanced local repair AODV)

In 2009, Jagpreet Singh and Paramjeet Singh, Shaveta Rani [8] proposed that ELRAODV takes advantage of fact that after red node gets down node-2 still contain route to the destination. Instead of discarding the whole route, node-1 can start repairing same route to node-2 by finding an alternative to the broken node i.e. through neighbours of the node-1. If node-1 able to find an alternative neighbour node which has node-2 as its neighbour as well, then link can be repaired by unicast a request (LRREQ) from node-1 to node-2 via alternative new hop (shown green) without broadcasting any RREQ. In other case if node-1 not able to find any alternative neighbour for repairing route then earlier local repair using broadcast RREQ can be utilized. But there are two major problems in implementing proposed concept.

7. Stability based Route Repairing

In 2010, Saleem Sheikh Aalam and Dr. T.Arul Doss Albert Victorie [9] proposed that AODVSRR the intermediate node finds a new shortest and maximum stability route to the destination; it updates its route table with new route, even if the forwards neighbour node repairs the link break and received a RROK message from repaired node. After establishing the new route the intermediate node sends packet which are stored in its cache. In worst case each intermediate node cannot repair the break link and cannot find a new route to the destination. Then, RERR message will receive by source node. In this case, AODVSRR source node selects the already found the shortest path with maximum stability route broadcasts a data packet with maximum stability route broadcasts a data packets to the destination.

8. Alternate route entry at node

In 2011, Rakesh Kumar and K.V. Arya[10] proposed that when a link break two nodes A and B, node A will look in its routing table to check whether it has any alternate route for destination D. It finds an alternate route entry E as secondary route. The node A will forward data packet to node E and send Route Error (RERR) packet to source S to re initiate the route discovery process.

9. Multi-hop

In 2009, Harisavan Somnuk and Mayuree Lertwatechakul [11] proposed that Multi-hop partial route recovery. The methodology based on local repair mechanism of AODV – 2T that has improved route maintenance in Ad hoc network by preparing backup route in a proper time. The mechanism works quite well in decreasing number of route breaks and then gains more network throughput. There are three steps:

Step 1: Detects link break & received signal compared with threshold.
Step 2: Broken link node send Sub_RREQ to its neighbours. It sends source address & destination of damaged route using Sub_RREQ.
Step3: Node receives Sub_RREQ packets lookup its forwarding table.
If forwarding table contain routing information for specified destination or not.
If it available it sends with Sub_RREP.

10. AODV Backup routing

In 2000, Sung-Ju Lee and Mario Gerla [12] proposed that when a node detects a link break, it performs the one hop data broadcast to its immediate neighbour. The node specifies that in data header the route is break and the packet is sending for "alternate routing." When neighbour node receiving this packet, it finds alternate route in its alternate route table. And send this packet to its next node. Data packet can be delivered through one or more alternate routes and are not dropped when route break occur.

11. Adaptive Route Selection

In 2009, Yuh-Chung Lin and Chu-Wei Ke [13] proposed that when source node likes to transmit data to destination node, the intermediate node will receive RREQs from other nodes. If the first RREQ received from intermediate node. The other route will record in cache table. So, these values in cache table will be referenced when intermediate node receives a RREP and needs to select appropriate route. When receiving a RREQ, the intermediate node will check if the value of Route_record in RREQ exists in the cache table. If yes, the RREQ will simply be discarded; otherwise, it represents a new disjoint and is recorded in the cache table.

IV. COMPARISON OF VARIOUS TECHNIQUES FOR LOCAL ROUTE REPAIR

TABLE I

Technique Name	Method Summery
On-demand Route maintenance in Multipath AODV (ORMAD)	When link failure detect in primary route, ORMAD starts local route repair in upstream and downstream nodes of broken link. It applies RMP only to the efficient routes, Which enhance route efficiency and minimize routing overhead.
Static node in realistic mobility model	After route discovery process, find the static nodes in route. Static nodes have buffer to store data packets. When static nodes are found in route, buffer is attached to each static node for store information in case of link failure.
Alternate backup route	Robust AODV with Local Update, the route is built on demand and maintained locally. Also built another routes for back up. When current active route is break highest priority backup route will be switched to become new active route.
Parallel route recovery	When packet do not reach at destination. To solve this problem, link failure generates temporary parallel route request using neighbour nodes to reach the destination. Temporally route request broadcasted by intermediate node.
Enhancing Route Recovery for QAODV	End-to-end delivery ratio and throughout using QAODV-I are higher compared to QAODV. (QAODVI – Qos AODV Intermediate node)
ELRAODV	In ELARAODV, A gets down B still contain route to the destination. Without discarding whole route A can repair the route using B. Without broadcasting any RREQ repaired by unicast request from A to B
Stability based Route Repairing	In AODVSRR use maximum stability field to establishing new route. Adding the routing repair mechanism to the RREQ message instead of initiating routing discovery as far as possible. These improvements not only reduce the packet loss rate and the end-to-end latency. And also enhance utilization rate of the network resources.
Alternate route entry at node	When a link break between two nodes A and B, node A will look in its routing table to check whether it has any alternate route for destination D. It finds an alternate route entry A will forward data packet to node E, and send RERR packet to source S and initiate the route discovery process.
Multi-hop AODV-2T	Multi-hop AODV-2T gives a better performance compared to the original AODV. Route maintenance concept inherits most the features of AODV-2T that is proved as practical idea to be used in reactive Ad-Hoc network.
AODV Backup routing	In route repairs problem data packets can be delivered through one or more alternate routes and are not dropped when route breaks occur.
Adaptive Route Selection	When route will discover by source at that time multipath found. This path will be used when route recovery process needed.

V. CONCLUSION

Changes in topology will break route source to destination. At that time two types of route maintenance procedures are available. One of them route maintenance procedure is local route repair. Here, in this paper several techniques for local route repair are discussed, which can be used for further research work.

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