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Local Route Repair Mechanism for AODV

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Abstract: ***With the dynamic nature of Ad-hoc Networks coupled with the mobility of nodes results in breakage of the links due to ever changing topology of the nodes. When there is a substantial increase in the degree of mobility of the wireless network more link errors are likely to occur. When this happens, route repair is typically performed to establish a new route. Such route repair mechanisms suffers with the problems like high control overhead and long packet delay making them inefficient due to frequent failures of intermediate connections in an end-to-end communication. When there is a breakage in the intermediate link, it is favorable to discover a new route locally without resorting to an end-to-end route discovery. In this paper, a new idea on local route repair (LRR) mechanism that the repair is confined to the vicinity of the broken link is proposed to decrease the reaction time of recovery and the overhead of route maintenance. The route repair idea is implemented by improving repair mechanism in the widely accepted AODV protocol. The proposed version of AODV routing protocol with route repair scheme overcomes the disadvantages of its antecedent. In the earlier AODV routing protocol, on the occurrence of a link break an error message is sent to the source stating that a link failure has taken place and further communication is stopped temporarily. Where as in the proposed version of AODV, nodes in the active path between source and destination act as a virtual source when link breakage occurs and there by the search process is continued till the link is formed to reach the original destination is reached.***

Keywords: Mobile Ad-Hoc Network, AODV, Local Route Repair.

I. INTRODUCTION

Ad Hoc on-demand distance vector routing (AODV) is a reactive routing protocol of mobile Ad Hoc networks. When a new route is needed, the source node broadcasts a Route Request (RREQ) message. Any node without a route to the destination rebroadcasts the RREQ. Otherwise, if the node has a route to the requested destination, it sends a Route Reply (RREP) message to the source node. When the source node receives a RREP, the route is established and the source can start using it. If data is flowing and a link break is detected by the intermediate node, a Route Error (RERR) message is sent to the source of the data in a hop-by-hop manner. As the RERR propagates towards the source of the network, each transitional node invalidates routes to the destinations that have now become unreachable. When the source of the data receives the RERR it disprove the route and reinitiates route discovery if necessary [2].

In this paper, a local repair scheme based on link breaks for MANET is proposed. When a link break occurs, the node that is upstream of the lost link (i.e. the repairing node) classifies the link breaks and adopts different methods for different link breaks depending on the status of its downstream node.

II. RESEARCH EFFORTS ON LOCAL REPAIR

Various novel algorithms have been proposed by researchers to improve AODV when links break. Srinath, P., Abhilash, P., & Sridhar, I. presented a strategy called Router Handoff. In this approach if at a certain point a node that detects one of its links weakening, it preemptively hands off routing information to a node that is suitably situated. This resulted in routing around the weak links and prevented the route from being broken [7]. Crisostomo, S., Sargento, S., Brandao, P., & Prior, R.. have proposed a Preemptively Local Route Repair scheme aiming to avoid route failures by preemptively local repairing routes when a link break is about to occur. Their Proposal was to enhance node information referring to link stability to its neighbors resorting to HELLO messages which were appended with a mobility extension containing the position of the node, a motion vector and a timestamp associated with it [3]. Based on the concept of localizing the route request query, Pan, M., Chuang, S. Y., & Wang, S. D. have proposed an approach to repair error links quickly. The authors have tried to improve the current implementation of local repair in AODV in order make the implementation cost effective. The metric used to evaluate the mechanism is based on no. of successfully transmitted packets in a period [5]. Bai-Long, X. I. A. O., Wei, G., Jun, L., & Si-Lu, Z. have proposed a new mechanism for route repair by modifying the information contained in the packets(RREQ and RREP) of AODV-LLR so as the repair is only confined to the vicinity of the broken links. In this mechanism if the intermediate node detects that the link to the next hop is broken, it then consults its routing table. If it finds a valid entry for next-to-next hop node, the intermediate node increments the SC (Sequence Counter) for the destination and broadcasts a Repair_RREQ message with

a TTL=k for the next-to-next hop node. If the Repair_RREQ message reaches the next-to-next hop node through some other intermediate node, it generates a Repair_RREP and unicast the message to the Repair initiator [1].
AODV as described by Perkins, C., Belding-Royer, E., & Das, S. [6] tends to repair the broken route if the node is near to the destination node. Otherwise, if the break node is very distant from destination node, a RRER message is propagated back to source node and the source node rebroadcast RREQ to find a new route. Unlike AODV, the approach proposed in this paper can repair break route without considering the distance between the broken node and the destination node.

III. PROPOSED ROUTE REPAIR MECHANISM

As intermediate nodes are usually nearer to the destination than the source node, the intermediate nodes on the route are comparatively more suitable in comparison to the source node to broadcast the RREQ message in order to repair or find an alternate route to the destination. Based on this idea we adopted the intermediate nodes that were en-route to repair the broken route to the destination. The standard version AODV protocol uses three types of packets for communication viz. RREQ(Route Request), RREP(Route Reply) and RERR(Route Reply). In addition to these three communication packets we have introduced three more packets viz. R_R(Route Repairing), RR_OK(Route Repair OK), RR_F(Route Repair failure).

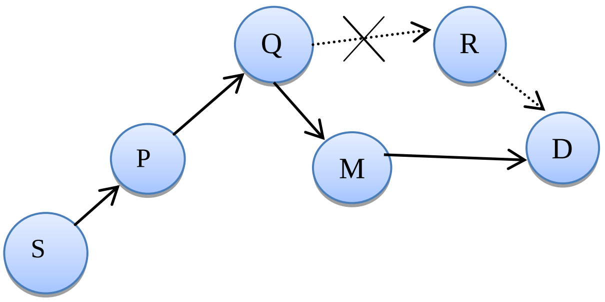

Figure 1: Diagram depicting invalidation of route

If data is flowing from S to D via nodes P,Q, R and a link break is detected by the intermediate node Q, Q does not send a RERR to the source of the data S. Instead, it sends a Route Repairing (R_R) message back to the pre-hop node P. After sending R_R to P, Q tends to broadcast RREQ to repair the break route. If Q cannot repair the route in certain amount of time, it sends back a Route Repair Fail (RR_F) message to P. And at same time Q sends the data packages, which store in the cache, back to P. Otherwise, once Q repairs the route in time, it sends back a Route Repair OK (RR_OK) message to P which has received a R_R message.
Once node P receives a R_R message, it caches the data packages sent to the destination. If P, which is not the source node of the data has received a RR_F message from the break node, P sends a R_R message back to the pre-hop of itself and continues the same procedure. On the contrary, if node P received a RR_OK message which means the break link is repaired by Q, it sends all waiting data packages stored in the cache.

In the worst situation, each intermediate node cannot repair the break link and cannot find a new route to the destination. Then, the source node will consequently receive a R_R message. In this scenario the proposed scheme will have the same operations as the standard AODV. The source broadcasts a RREQ message to find a new route to the destination.

IV. SIMULATION AND RESULTS

In order to study the behavior of nodes we have simulated the standard AODV protocol in the network simulator ns-2.34 and observed results for various QOS metrices like Throughput, Packet Delivery Ratio, Energy and Average Delay. Our Simulations adopt a network of 50 nodes within an area of 500 meter square using CMU setdest module [4]. We conducted simulations for CBR and TCP data flows. The antenna type used is Omnidirectional with maximum packets in queue is 200. Simulations are run for 2, 4, 6, 8 and 10 seconds.

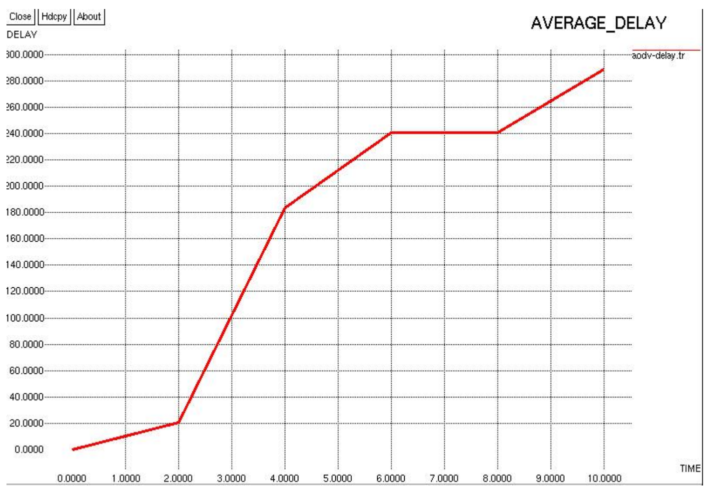

Figure 2: Illustration of the delay vs time

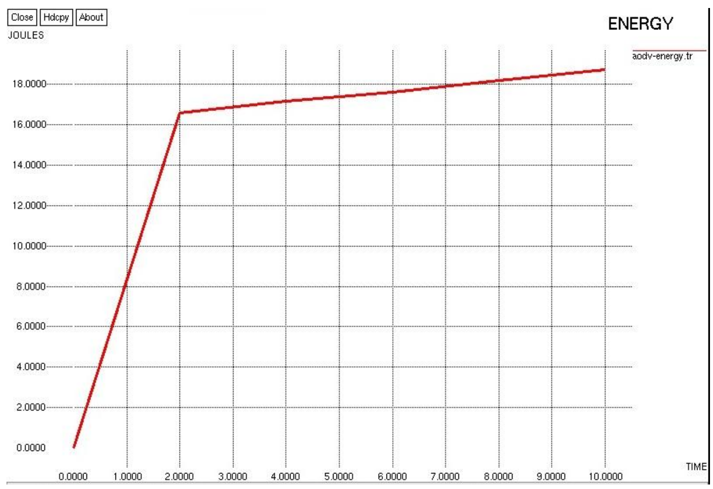

Figure 3: Illustration of the energy vs time

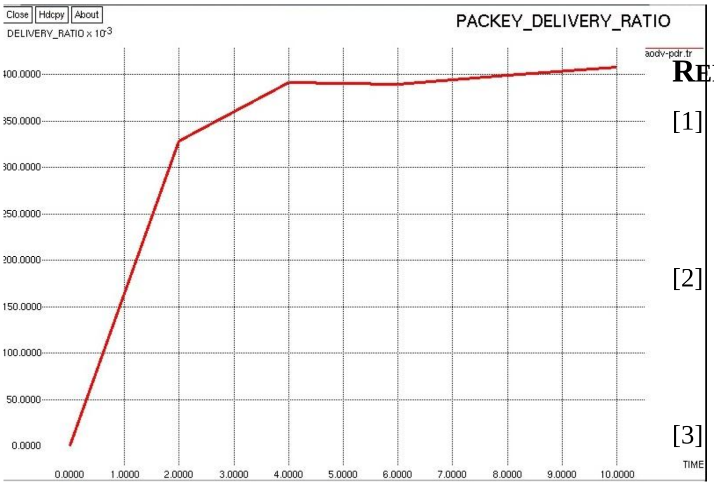

Figure 4: Illustration of the delivery ratio vs time

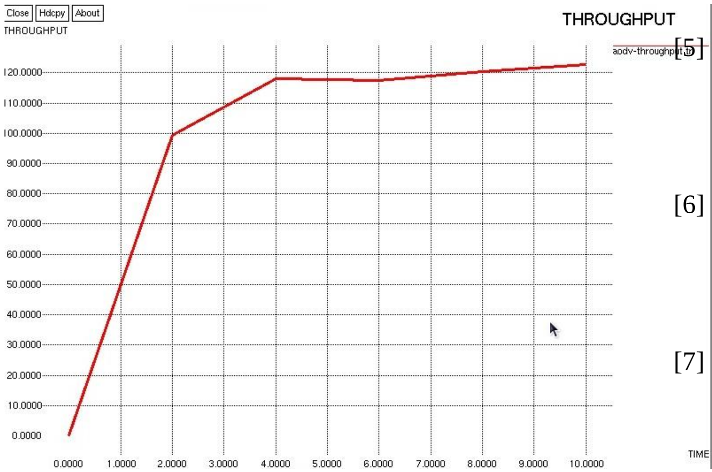

Figure 5: Illustration of the throughput vs time

V. CONCLUSION

In this paper we have identified and reviewed some of the techniques that have been proposed for local route repair by various researchers to increase the efficiency of the standard route discovery and maintenance procedures employed by AODV protocol. In addition we have proposed a new scheme of route repair which can be incorporated in standard AODV for improved performance. Finally we have simulated the standard version of AODV protocol in order to gain the basic understanding of behavior of nodes in a Mobile Ad-Hoc Network.

VI. FUTURE WORKS

Future work involves the actual implementation of the proposed scheme of route repair within the vicinity of broken links, its incorporation in the AODV protocol and, its performance comparison with the standard AODV protocol on various QOS matrices like Throughput, Packet Delivery Ratio, Energy and Average Delay.

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