



## ENHANCED AODV-BACKUP ROUTING IN MOBILE AD HOC NETWORKS

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**Abstract-** Nodes in mobile ad hoc networks communicate with one another via packet radios on wireless multihop links. Because of node mobility and power limitations, the network topology changes frequently. Routing protocols therefore play an important role in mobile multihop network communications. Most of the protocols in this category, however, use single route and do not utilize multiple alternate paths. In this paper, we propose a scheme to improve existing reactive routing protocols by creating a mesh and providing multiple alternate routes. A modification in AODV-BR algorithm has been proposed keeping in view the higher extent of mobility in ad-hoc wireless mobile network. AODV-BR considered mobility of nodes to a limited extent wherein it considered the case of failure of primary link only and taken for granted for the non failure of alternate path. We have considered the case when there is failure of both primary and alternate path due to mobility of nodes.

**Keywords-** MANNET, Reactive routing protocols, AODV

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### Introduction

Ad hoc networking [8], [9] has emerged as one of the most focused research areas in the field of wireless networks and mobile computing. Ad hoc networks consist of hosts communicating one another with portable radios. These networks can be deployed impromptu without any wired base station or infrastructure support. In ad hoc mobile networks, routes are mainly multihop because of the limited radio propagation range, and topology changes frequently and unpredictably since each network host moves randomly. Therefore, routing is an integral part of ad hoc communications, and has received interests from many researchers. Furthermore, the wireless channel is also a shared-access medium and the available bandwidth also varies with the number of hosts contending for the channel.. Due to its ease of deployment and no centralized control unit, mobile nodes can connect with each other in any form of network topology at anytime. All mobile nodes serve as routers and maintain the dynamic time-varying network topology. In MANETs, multicasting service plays an important role in bandwidth saving for some applications such as emergent events one to- one unicast transports. Without multicast capability, data Stream must be sent

to all receivers by multiple unicast connections. Several researchers deal with this issue recently. The network utilization will become inefficient and much more transmission and control overheads will be introduced [2]. There are many multicast protocols in traditional wired networks such as Distance Vector Multicast Routing Protocol(DVMRP [3], Multicast extension to the Open Shortest Path First (MOSPF) [4], Core Based Trees (CBT) [5], Protocol Independent Multicast (PIM) [6] and so on. Unfortunately, due to the change of the dynamic topology with time in MANET, several issues, as processing overhead, packets collisions, and route maintaining, need to be overcome. There are some multicast protocols proposed in MANET. Bandwidth-Efficient Multicast Routing Protocol (BEMRP) [6] is a tree based multicast protocol. The main idea of this protocol is to find a nearest forwarding node to replace with finding the shortest path between the source node and the receiving node for decreasing the number of packet transmission. However, it does not consider the impact of data transport over TCP. Multicast Adhoc On-Demand Distance Vector Routing Protocol (MAODV) [7] is a modified version of AODV [1]. In MAODV, each node of MANET must send control packets peri-

odically to maintain the topology. Weight-Based Multicast Protocol (WBM) [21] is also a tree based multicast protocol. However, it not only considers the transmission hop but also considers the overhead of the forwarding path. Generally, the above schemes consider the multi path connection at routing layer and leave the issue of reliable transmission being dealt with at upper layer. The rest of the paper is organized as follows. The problem statement is given in section 2. The proposed model and algorithm to solve the problem is given in section 3. The comparative results are discussed in section 4. Finally, conclusions and future work are discussed in Section 5 and 6 respectively.

### Design Space and Related Work

There are a couple of multicast protocols that rely on the mesh topology for communications between multicast members: the On-Demand Multicast Routing Protocol (ODMRP) and the Core Assisted Mesh Protocol (CAMP). Because of the richer connectivity of a mesh, these protocols have been shown to perform well compared with tree based single route protocols. The unicasting, can also use alternate paths provided by the mesh to deliver data packets when the primary route becomes routing, however, suffers from some limitations. Data packets are propagated in duplicates through multiple routes at all instances, thus creating excessive redundancy that causes congestion and collision. In AODV-BR [1] algorithm, on the contrary, multiple alternate paths are utilized only when the primary route is disconnected/failure.

The proposed protocol is to remove one of the limitations of the AODV-BR i.e. consideration of mobility of nodes in the network. In AODV-BR algorithm there is a consideration of mobility of nodes for alternate path concept was used but it did not consider for the case where there is failure of both primary and alternate link. The proposed algorithm deals with this condition. It basically uses AODV-BR algorithm in its core with additional feature dealing with case of failure of both primary and alternate path.

### Proposed Algorithm

In this section, we present the operation details of our scheme. Since the purpose of our study is to improve the performance of existing on-demand protocols (specifically AODV-BR in this paper), our protocol description is based on AODV-BR. Our modifications to AODV-BR for applying our scheme are also introduced.

### Route Construction

Our scheme can be incorporated with reactive routing protocols that build routes on demand via a query and reply procedure. Our algorithm does not require any modification to the AODV-BR's RREQ (route request) propagation process. When a source needs to initiate a data session to a destination but does not have any route information, it searches a route by flooding a ROUTE REQUEST (RREQ) packet. Each RREQ packet has a unique identifier so that nodes can detect and drop duplicate packets. An intermediate node, upon receiving a non-duplicate RREQ, records the previous hop and the source node information in its route table (i.e., backward learning). It then broadcasts the packet or sends back a ROUTE REPLY (RREP) packet to the source if it has a route to the destination. The destination node sends a RREP via the selected route when it receives the first RREQ or subsequent RREQs that traversed a better route (in AODV for instance, fresher or shorter

route) than the previously replied route.

The mesh structure and alternate paths are established during the route reply phase. We use the similar method of AODV-BR protocol in this procedure. Taking advantage of the broadcast nature of wireless communications, a node promiscuously "overhears" packets that are transmitted by their neighbouring nodes. From these packets, a node obtains alternate path information and becomes part of the mesh as follows. When a node that is not part of the route overhears a RREP packet not directed to itself transmitted by a neighbour (on the primary route), it records that neighbour as the next hop to the destination in its alternate route table. A node may receive numerous RREPs for the same route if the node is within the radio propagation range of more than one intermediate node of the primary route. In this situation, the node chooses the best route among them and inserts it to the alternate route table. When the RREP packet reaches the source of the route, the primary route between the source and the destination is established and ready for use. Nodes that have an entry to the destination in their alternate route table are part of the mesh. (see Fig. 1)

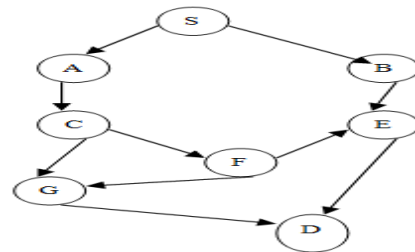


Fig. 1- Multiple routes

### Route Maintenance and Mesh Routes

There are following cases for route Maintenances

#### Case 1: When the primary links does not fail

In this case primary links are used. This is the case when all the mobile nodes which constitute the path does not move so that the link between them is not failed. This is the very normal case and it does not require any special handling.

#### Case 2: When the primary link fails but there is existence of alternate link

Data packets are delivered through the primary route unless there is a route disconnection. When a node detects a link break node1 does not receive passive acknowledgments from node 2 a hello packets for a certain period of time, it performs a one hop data broadcast to its immediate neighbour. The node specifies in the data header that the link is disconnected and thus the packet is candidate for "alternate routing." Upon receiving this packet, neighbour nodes that have an entry for the destination in their alternate route table, unicast the packet to their next hop node. Data packets therefore can be delivered through one or more alternate routes and are not dropped when route breaks occur. To prevent packets from tracing a loop, these mesh nodes forward the data packet only if the packet is not received from their next hop to the destination and is not a duplicate. When a node of the primary route receives the data packet from alternate routes, it operates normally and forwards the packet to its next hop when the packet is not a dupli-

cate. The node that detected the link break also sends a ROUTE ERROR (RERR) packet to the source to initiate a route rediscovery. The reason for reconstructing a new route instead of continuously using the alternate paths is to build a fresh and optimal route that reflects the current network situation and topology. Our alternate route utilization mechanism is similar to AODV-BR scheme which uses the mess link only to go around the broken part of route.

**Case 3: When both primary and alternate links are failed**

In this case the node which discovered failure of both primary and alternate links broadcast a route request packet in the similar fashion as was done during the route construction phase and sends the route error packet to source. The node which discovers failure of both primary and alternate link will send route error (RERR) packet having a sequence number, to the source and it also broadcast a route request(RREQ) packet with the same sequence number as that of route error (RERR) packet with source as this node (fig. 2. (b)) and destination being the same as original one, and in message header a additional field alternate-source having its value as this node is added. The node which receives both RERR and RREQ packet with same sequence number will simply drop the RREQ packet and processes RERR only, but the node which receives only RREQ packets will broadcast it again, as was done in route construction phase. After the reconstruction of primary and alternate link the message with the modified message header is forwarded on the newly constructed primary link (fig. 2. (c)).

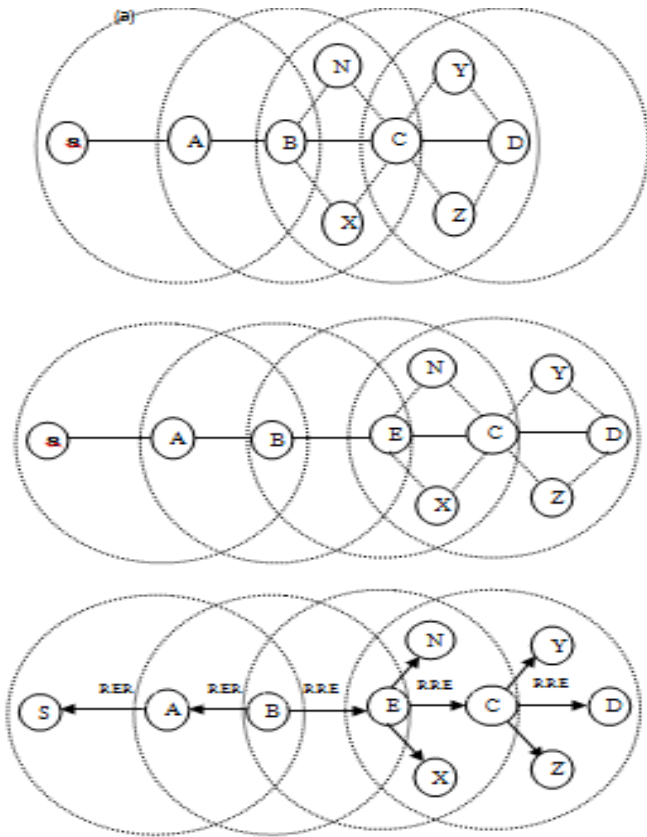


Fig. 2- Multiple route construction and their usage: (a) showing existing primary and alternate links (b) flow of RERR and RREQ packets (c) construction of new primary and alternate links

**Simulation Result**

We evaluate the performance of EAODV-BR through simulations. The simulation of EAODV-BR was written in C language several measurement metrics were collected from our proposed simulator to evaluate the performance of EAODV-BR. The data packet delivery ratio is defined as the number of successfully delivered data packets to the number of data packets generated by the source. The former reflects the cost in transmitting control packet, and the other represent the efficiency of packet delivery. The data delivery ratio affected by multicast size. Size defines the number of member nodes in each multicast group. Node number defines the number of total mobile nodes in Network, it is found that the data delivery ratio decreases as the size increases. On the other hand, we compare the end to end delay.

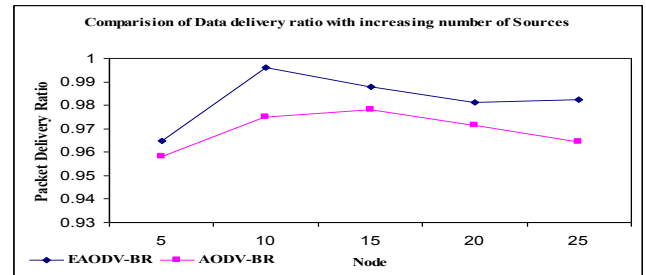


Fig. 3-

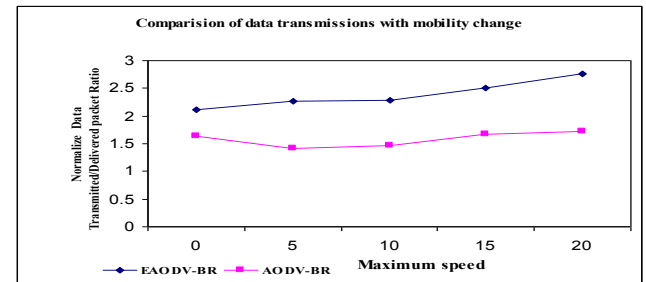


Fig. 4-

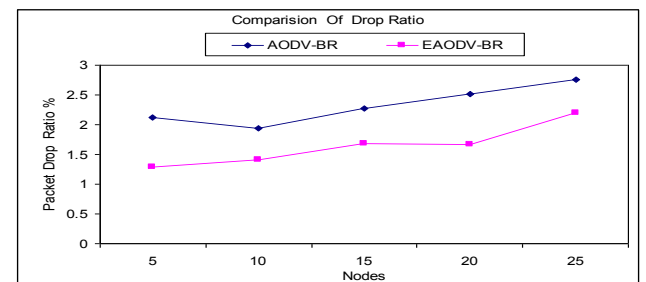


Fig. 5-

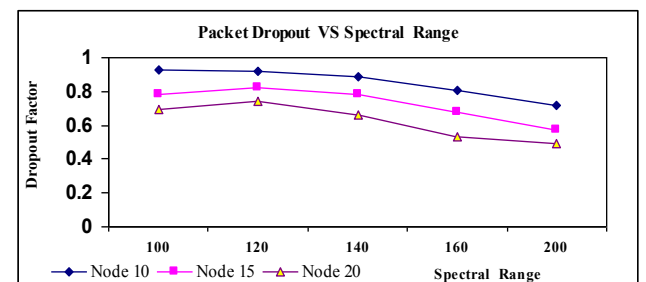


Fig. 6-

## Conclusion

In this paper we proposed an algorithm for Mobile Ad-hoc Network (MANET) novel scheme EAODV-BR (Enhanced AODV with Backup Routing). The algorithm will mostly transfer the packets from source to the destination in mobile Ad-hoc networks even in the conditions where earlier scheme fails to transfer. It is compared to traditional schemes. The simulation shows end-to-end delay is presented in Fig. 3. As expected, EAODV-BR has longer delays than AODV-BR. We can only measure delays for data packets that survived to reach their destination. EAODV-BR delivers more packets, and those packets that are delivered in EAODV-BR but not in AODV-BR, take new routes by reconstruction of the routes. EAODV-BR having longer delays than AODV-BR does not represent its ineffectiveness since these protocols use the same primary route and alternate route. Because EAODV-BR and AODV-BR both have the same amount of control message overhead, we used a different metric for efficiency evaluation. We present the number of hop-wise data transmission per data delivery to the destination in Figure-3 to Figure-5. We can observe that EAODV-BR transmits slightly more data packets than AODV-BR. The reason being when both primary and alternate route break occurs, EAODV-BR uses reconstruction of route to deliver packets that are dropped in AODV-BR, as explained above.

## Future

The scheme does not perform well under heavy traffic networks. In future there is scope of investigating ways to make protocol robust to traffic load. Additionally, there can be further evaluation of this protocol scheme by using more detailed and realistic channel models with fading and obstacles in the simulation.

## References

- [1] Sung-Ju Lee, Mario Gerla, *Wireless Adaptive Mobility Laboratory Computer Science Department University of California, Los Angeles Los Angeles.*
- [2] Quinn B., Almeroth K. (2001) *IP Multicast Applications: Challenges and Solutions.*
- [3] Waitzman D., Partridge C., Deering S. (1988) *Distance Vector Multicast Routing Protocol.*
- [4] Moy J. (1994) *Multicast Extensions to OSPF.*
- [5] Ballardie A. (1997) *Multicast Routing Protocol Specification.*
- [6] Ozaki T., Kim J.B., Suda T. (2001) *IEEE INFOCOM.*
- [7] Royer E.M., Charles E. Perkins (1999) *MOBICOM*, 207-218.
- [8] Joseph Macker. et al., *Internet Engineering Task Force (IETF) Mobile Ad Hoc Networks (MANET) Working Group Charter.*
- [9] Garcia-Luna-Aceves J.J., Madruga E.L. (1999) *IEEE Journal on Selected Areas in Communications*, 17(8).
- [10] Garcia-Luna-Aceves J.J., Madruga E.L. (1999) *IEEE Conference on Computer Communications* 784-792.
- [11] Lee S.J., Su W., Hsu J., Gerla M., Bagrodia R. (2000) *IEEE International Conference on Computer Communications*, 565-574.
- [12] Shacham N., Craighill E.J., Poggio A.A. (1983) *IEEE Journal on Selected Areas in Communications* 1(6), 1084-1097.