IMPROVING PERFORMANCE OF MANETS USING CUCKOO SEARCH FOR ROUTE MAINTENANCE IN AODV

Simarjit Singh[1], Er. Chamkaur Singh[2]

[1]*Research Scholar,* [2]*Assitant Professor, CSE Department*

Guru Gobind Singh College of Engineering and Technology, Guru Kashi University, Talwandi Sabo, Bathinda, India.

Abstract: The nodes in mobile ad hoc networks keep on experiencing the link breakages with their neighboring nodes. To maintain the links these nodes execute the route maintenance phase described in reactive routing protocols such as ad hoc on demand distance vector (AODV) routing protocol. The bad links lead to loss of data in the network. The paper describes the use of cuckoo search optimization algorithm to rebuild the broken route. The performance of the network has been compared to existing scheme based remaining energy, packet delivery ratio and throughput of the network. These parameters have shown an improvement over the existing scheme.

Keywords: MANETs, AODV, link breakage, cuckoo search optimization

I. INTRODUCTION

The development of routing protocols is of the important subjects within Mobile Ad Hoc Networks (MANETs), which have to deal with the typical limitations of wireless networks, including low bandwidths, high error rates, and power limitations. The main functions of MANETs protocols are to establish, maintain, and perform route repair in the event of broken links. Numerous routing protocols have been developed to cater the needs of wireless networks, or MANETs [1–3].

Due to changeable topology, routes from sources to destinations may be suddenly broken and nodes have to discover other available routes to deliver data [4]. The ad hoc on-demand distance vector routing algorithm (AODV) was proposed as a reactive routing algorithm to allow mobile nodes to quickly adapt to topology changes and link breaks in mobile ad hoc networks. To find a possible route, the AODV makes a source flood a routing request message over the network and discovers a route based on the principle of the shortest path. The amount of overhead messages for route discovery and route maintenance depends on the longevity of routing paths. The awareness of link and path durations can improve routing performance in such mobile networks.

This paper describes existing techniques or routing protocols that focus on reducing the link breakage in mobile ad hoc networks in Section II. Section III describes proposed methodology which is modification to AODV based back up routing technique. Results for the proposed technique have been described in Section IV and finally the paper has been concluded in the last section.

II. LITERATURE REVIEW

This paper [5] presents a new routing algorithm that is more suitable fora MANET in the sparse environment. This routing algorithm is based on AODV (Ad hoc on demand distance vector), where it stores all the available paths. So whenever the link between the nodes gets break, it can immediately

replace with the new route. To select the best path, it considered energy metric along with hop count. These modification in AODV routing protocol reduced the number of route discovery procedure. Simulation results shows that, there is a significant improvement in packet delivery ratio with reduction in packet loss ratio, routing overhead and average end to end delay.

This paper [6] analyzes how energy consumption of the mobile devices and density of mobile nodes affects the performance of MANET. AODV is a reactive routing protocol used in MANET which handles link break due to node mobility and energy drain. In this paper, the performance of AODV is compared with the proposed E-AODV for link breaks using ns2 simulator. The outcomes reveal that E-AODV can perform in a better way when it comes to issues like throughput, end to end delay and packet delivery ratio compared to AODV only in presence of large network size and high mobility of nodes. Energy consumption and normalized routing load is high for E-AODV compared to AODV for all scenarios.

This paper [7] proposes a novel cross-layer approach called congestion-adaptive and delay-sensitive multirate (CADM) routing protocol in MANETs. The CADM protocol exploits the cross-layer interaction between the network layer, MAC, and physical layer. The CADM accesses the correlation between data rate, congestion metric, and MAC delay in delay-sensitive applications to provide enhanced network efficiency in MANETs. The protocol discovers multiple node-disjoint routes and facilitates optimal data rates between the links based on the estimated delay to admit a flow with the certain delay requirement in multirate MANETs. The proposed CADM protocol discovers the route through less congested nodes and also actively handles the congestion if it occurs. The performance of the CADM protocol is comprehensively assessed through the simulation, which highlights the advantages of our cross-layer mechanism.

In this paper [8], a routing scheme named Mobility, Residual energy and Link quality Aware Multipath (MRLAM) is proposed for routing in MANETs. The proposed scheme makes routing decisions by determining the optimal route with energy efficient nodes to maintain the stability, reliability, and lifetime of the network over a sustained period of time. The MRLAM scheme uses a Q-Learning algorithm for the selection of optimal intermediate nodes based on the available status of energy level, mobility, and link quality parameters, and then provides positive and negative reward values accordingly. The proposed routing scheme reduces energy cost by 33% and 23%, end to end delay by 15% and 10%, packet loss ratio by 30.76% and 24.59%, and convergence time by 16.49% and 11.34% approximately, compared with other well-known routing schemes such as Multipath Optimized Link State Routing protocol (MP-OLSR) and MP-OLSRv2, respectively. Overall, the acquired results indicate that the proposed MRLAM routing scheme significantly improves the overall performance of the network.

In this dissertation [9], the authors have proposed a link breakage prediction algorithm. It works on RSS-Distance based multicast methodology under the multicast communication. In which the nodes calculate the link breakage time and further warns

the other nodes regarding the link breaks within the route. Based on this information, a new route discovery is initiated much sooner than the route breakage. The performance of the proposed link breakage prediction algorithm is compared with previous ODMRP and MORALISM. As it reduces packet drops, the average end-to-end delay. It also provides the best feasible path that reduces the packet loss and improves data packet delivery ratio within the network. The Proposed technique shows an improvement in the Quality of Service.

The objective of this paper [10] is to propose 2 protocols, the first based on link stability and the other based on route stability. The probability of successful transmission of periodic packets is used as a link stability metric to assess the stable path. Acknowledgment -free packets are used to check connectivity in the network. Increased probability of successful transmission implies that the selected link is sustained for longer duration and can deliver packets more reliably or, as a consequence, results in a stable link to deliver a better data rate. With a stable link, there is a reduced possibility of retransmissions, reduced end-to-end delay, reduced control overheads, and enhanced data delivery ratio. Selection of the most stable route for data transmission improves the performance. Experimental results from simulations performed on EXata/Cyber v2.0 simulator reveal that the proposed protocols are an improvement over the existing protocols in terms of packet delivery ratio, average end-to-end delay, and average route lifetime, even without route optimization with the minor increase in control packets. A case study of the application of proposed protocols is also presented.

III. PROPOSED METHOD

The proposed work will allow the nodes to follow AODV routing protocol to find route to the destination node. The first step of broadcasting the route request packets in the network will be same as the existing technique (that follows AODV). Each node will broadcast route request packets to the neighbors until the route to destination is found.

At this point, the destination node will compute the paths to the source node via which route request packets have been received. Until this, the existing scheme [5] and proposed scheme will work in the same manner.

The existing scheme allows the destination node to forward the route reply via all the paths. These paths are used as backup in case any route failure occurs. In the proposed scheme the destination node will only reply to the source node via single path for which the remaining energy of the nodes is maximum. When the source node receives the route reply, it will start sending data to the destination node.

In case of route failure, the cuckoo search algorithm will be used. When the route failure occurs, the nodes will execute the cuckoo search optimization to find new path. Each cuckoo/node will use the Levy's walk in the random manner. The x and y coordinates are updated according to the Levy's walk in random directions. The incremented step sizes will allow the nodes to find a nest/neighbor in their close vicinity. The neighbors found will be according to the latest topology change that has occurred in the network.

When the new nest or neighbor is found, the broken route can be repaired in the network. The source node can thus resume the communication over the new path to the destination node.

IV. RESULTS

The proposed scheme uses cuckoo search optimization to create back routes for the network in case of failure occurs. The proposed scheme as well as existing scheme were implemented in network simulator 2.35. The performance of the network was measured based on packet delivery ratio, throughput and remaining energy of the network.

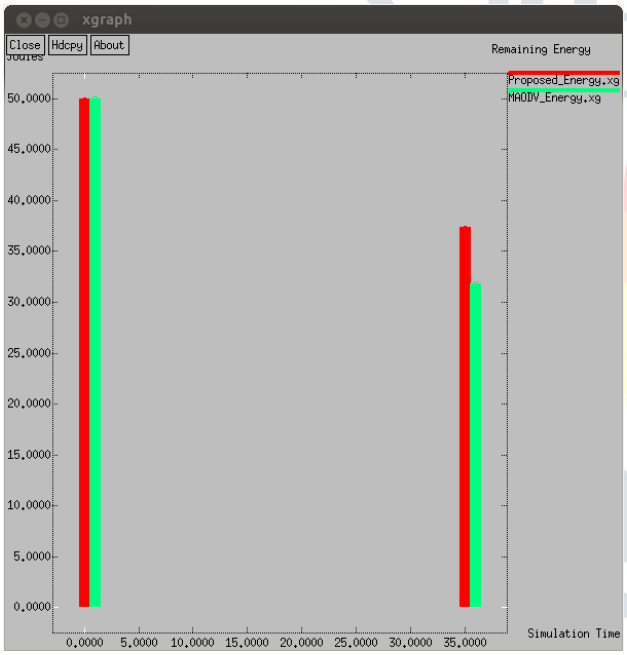

Figure 4.1: Remaining energy comparison

The above graph shows the comparison of remaining energy in the network for both the schemes. The initial energy in the network was 50 Joules and the remaining energy for the proposed scheme was 37.38 Joules. The remaining energy for the existing scheme was 31.85 Joules. This shows that the proposed scheme consumes less energy in the network than the existing scheme.

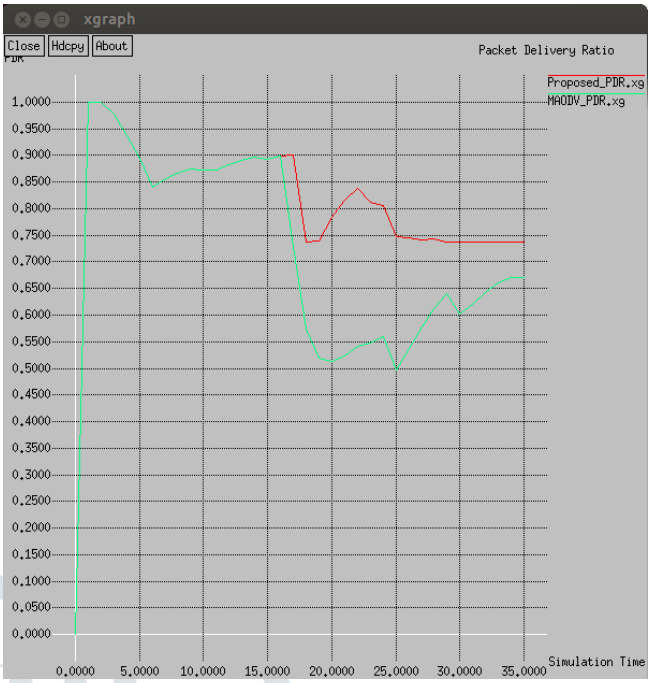

Figure 4.2: Packet delivery ratio comparison

The above graph shows the comparison of packet delivery ratio in the network for both the schemes. Initially the value of packet delivery ratio is less for both the schemes. This is because both the schemes execute the broadcasting phase to find route between source and destination node. The broadcasting creates congestion in the network leading to the packet drops in the network. At the later stage of data transmission, the value of packet delivery ratio for the proposed scheme was found at 73.65 and for the existing scheme was found at 67.04. This indicates less link breakage in the network for the proposed scheme.

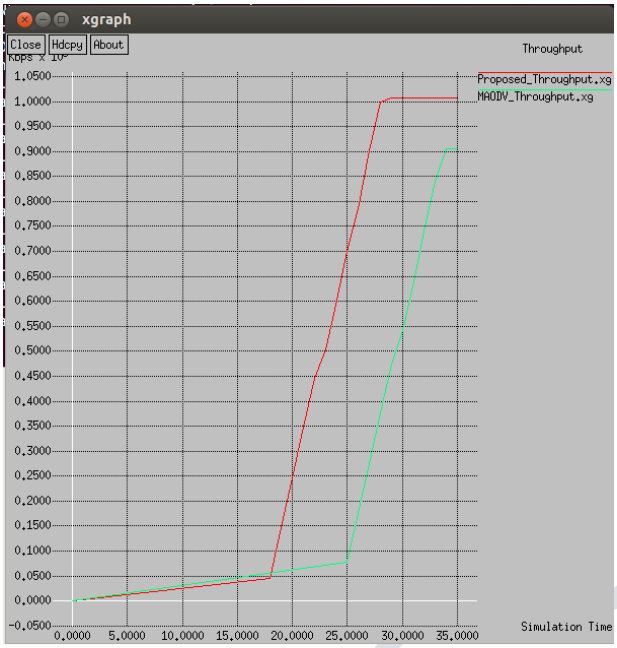

Figure 4.3: Throughput comparison

The above graph shows the comparison of throughput in the network for both the schemes. The value of throughput is 1007.62 Kbps for the proposed scheme and 905 Kbps for the existing scheme. This indicates that the destination node receives more amount of data in the network with the proposed scheme. The table below shows the values of the analyzed parameters for the proposed and existing schemes.

Parameter\Scheme	Proposed	Existing
PDR	73.65	67.04
Throughput	1007.62 Kbps	905 Kbps
Remaining Energy	37.38 Joules	31.85 Joules

Table 4.1: Results Comparison

V. CONCLUSION

The proposed scheme aimed at optimizing the backup based routing for the mobile ad hoc networks. The backup routes are required in case the link breakage happens. The cuckoo search optimization based backup route building was proposed in this study and performance of the network as analyzed based on packet delivery ratio, throughput and remaining energy of the network. The proposed scheme consumes less energy of the network because the route reply is done over the selected path instead of multiple paths in the existing scheme where the routes are selected later on. The higher value of PDR and throughput for the proposed scheme reflects that backup routes optimized after the link breakage were better as compared to using the old backup routes from the cache memory of the source node. Thus we can conclude that the proposed scheme outperforms the existing scheme.

In future, the security of the network can be considered along with this scheme. The security can be ensured with encryption based techniques such as MD5, SHA, RSA etc.

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