IMPROVED M-ECRR TO ALLEVIATE CONGESTION IN AD HOC NETWORKS

Mandeep Kaur[1], Rachna Rajput[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 ad hoc networks tend to use reactive routing protocols such ad hoc on demand distance vector (AODV), dynamic source routing (DSR) to find routes between source-destination pair. The broadcasting involved in such path finding mechanisms create congestion in the network which leads to decrease in packet delivery ratio (PDR) of the network. This paper algorithm that alleviates congestion in the network by choosing the nodes having lowest packet drop rate and lowest bandwidth consumption in the route request phase. The result has been compared with existing mixed-path end-to-end congestion relief routing protocol (MECRR) based on throughput, PDR and routing overhead. These parameters have shown improvement over the existing scheme.

Keywords: Ad hoc network, AODV, DSR, Route request, broadcasting, congestion, PDR.

I. INTRODUCTION

In recent times, there has been an immense growth in demand for support of multimedia applications over MANETs. Most of the real-time multimedia traffic tends to be in bursts and bandwidth demanding and is responsible for the congestion [1]. The congestion factor results in packet losses, retransmissions, and bandwidth degradation and also incurs additional time and energy on to recover from congestion [2]. For real-time traffic, the data rate and delay are the crucial QoS factors. When the packet drop ratio crosses the threshold limit, the network is identified to be congested [3]. In traditional ad hoc routing protocols, packet losses are assumed as a consequence of congestion. On the contrary, in MANETs, the routing protocols assume the packet losses are due to link failure and initiate the reroute discovery process to find the alternate route to the destination [4]. But in MANETs, the packets loses could be either due to link failure or congestion [5]. In congested networks, performing route discovery may not only be unnecessary, but it may also further increase congestion. Due to limited resources of energy and bandwidth available in MANETs, it is necessary to initiate the congestion control mechanism to improve the network performance.

This paper discusses the congestion aware routing techniques for ad hoc networks in next section. Section III presents the proposed congestion aware routing technique and their results have been shown in section IV. Finally the conclusion has been presented in last section of the paper.

II. LITERATURE REVIEW

The authors in [6] develop a mixed-path end-to-end congestion relief routing protocol (MECRR).According to the current network state information, MECRR decides whether or not to execute the multi-path scheme. When the path length is small and network load is light, M-ECRR operates the single path strategy; otherwise it operates the multipath strategy. Finally, they conduct extensive OPNET simulations to validate the performance of proposed routing protocols. The results indicate that compared with AODV, ECRR and M-ECRR can improve the network throughput, reduce the hop count and energy consumption, while ensuring the delay performance and control overhead.

In this paper [7], a congestion adaptive load balanced clustering scheme is proposed where the authors are emphasizing not only on the problem of appropriate cluster head selection, but also on assigning mobile nodes to cluster heads efficiently, based on the congestion status of cluster heads. Thus, the proposed algorithm revolves around three benefactions for load balanced clustering with congestion control, i.e. the selection of most suitable nodes to serve as cluster heads, minimizing the overall loads to cluster heads and congestion control, which improve network lifetime with minimal overhead. The simulation results demonstrate the effectiveness of the proposed clustering algorithm compared with the existing algorithms in terms of average number of clusters formed, average end-to-end delay, packet delivery ratio, average number of re-clustering required and network lifetime.

In this manuscript [8], Ant Colony Optimization (ACO) is collaborated with Fitness Distance Ratio Particle Swarm Optimization (FDR PSO) to efficiently handle and distribute network load. The node is intended to find the minimum bandwidth utilized path using ACO and FDR PSO congregates neighbor selection based on minimum queue utilization condition. The nodes are relayed with the acceptable packet count that is pre-estimated based on the observations of ACO and FDR PSO. This helps to prevent the node from being overloaded due to higher packet flow and non-periodic communications. The proposed ACO-FDRPSO approach is verified for its consistency over a 100 node scenario and the performance is analyzed by varying flows, number of nodes, flow rate and pause time for the network metrics throughput, PDR, delay and drop.

In this paper [9] the authors proposed a congestion control mechanism using load balancing technique, for this they firstly detect the congestion by monitoring the arrival rate of the packet for which we used an early congestion detection technique then less loaded path as compared to the present path has been adapted which decreases the chances for the occurrence of congestion and effectively use the network, reducing packet delay while increasing the packet delivery ratio.

This paper [10] presents a simple and efficient enhanced GFS routing algorithm called Intelligent Fuzzy logic Greedy forwarding Scheme (IFGFS). IFGFS consider the De-congestion level of each mobile node as another selective metric besides distance. In order to validate the algorithm, the authors rely on a wide simulation experiments. The evaluation results showed the correctness of the new proposed algorithm the adaptive- congestion IFGFS which maximize the performance of the network.

This paper [11] proposes a Congestion aware Link Cost Routing for MANET where the protocol finds a path with optimized linked cost based on SNR, Link delay, and the and remaining battery power.

Along with this optimization, in this protocol, every node finds its congestion status and participates in the route discovery on the basis of its status. Data forwarding is also done based on the congestion status at the time of forwarding. The protocol results in better performance in terms of packet delivery fraction, end to end delay, throughput, and packet drop when compared to existing protocols.

In this paper [12] the authors present an AODV based mechanism to avoid congestion before happening. In proposed scheme, the current bandwidth consumption is estimated to adjust according to available bandwidth. Feedback is provided to source node about current network state according to which source node adjust its data rate. They have simulated the scenario by using NS 2.35 using TCL and C language. Results are extracted from trace files using Perl scripts. The scheme proves the dominance over preliminaries in terms of packet delivery ratio and throughput.

III. PROPOSED METHODOLOGY

When the source node has some data to send to the destination node, it would execute the broadcasting phase. The source node will find the neighbors in its communication range and forward the RREQ packets to them.

Since congestion can also occur in the RREQ broadcasting phase, thus to alleviate congestion during this phase, if any node is found to drop the packets and its packet delivery ratio is less than 90 percent, then the node will not take part in the broadcasting process. When the RREQ reaches the destination node, it will formulate all the paths to the source node. It will calculate the congestion metric of the paths as:

$$\text{Congestion metric} = \alpha * \text{Packet Drop Rate} + \beta * \text{Bandwidth Consumed}$$

The destination node will send RREP to the source node over the paths along with their congestion metric. The source node will choose the path with lowest congestion metric to send the data to the destination node.

However, if after the first flow of data the congestion metric has increased for a particular path, then the source node can shift the data traffic to the other path as well.

IV. RESULTS

The congestion is one of the issues in ad hoc networks as talked about earlier in this study. The authors in one of the existing schemes [6] have presented the MECRR to combat congestion and we proposed modification to it. Both the schemes were implemented in network simulator. The performance of both the schemes were analyzed based on routing overhead, throughput and packet delivery ratio.

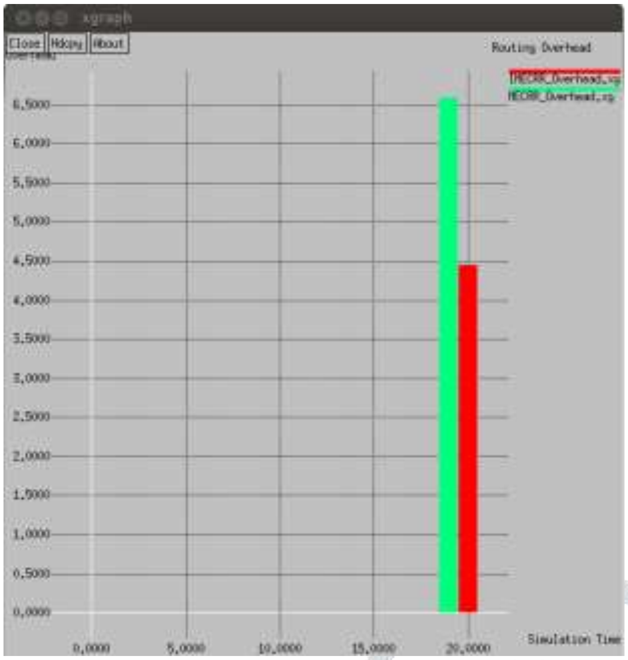

Figure 4.1: Routing Overhead Comparison

This figure shows the comparison for the routing overhead values achieved for both the schemes. The value of routing overhead for the proposed scheme is 4.44 and for the existing scheme is 6.59.

Figure 4.2: PDR Comparison

The value of packet delivery ratio shown in the graph for both the schemes is less in the starting. This is because the broadcasting of the route request packets creates congestion in the network leading to packet drops. The value of the PDR for the proposed scheme is 51.13 and for the existing scheme is 45.97.

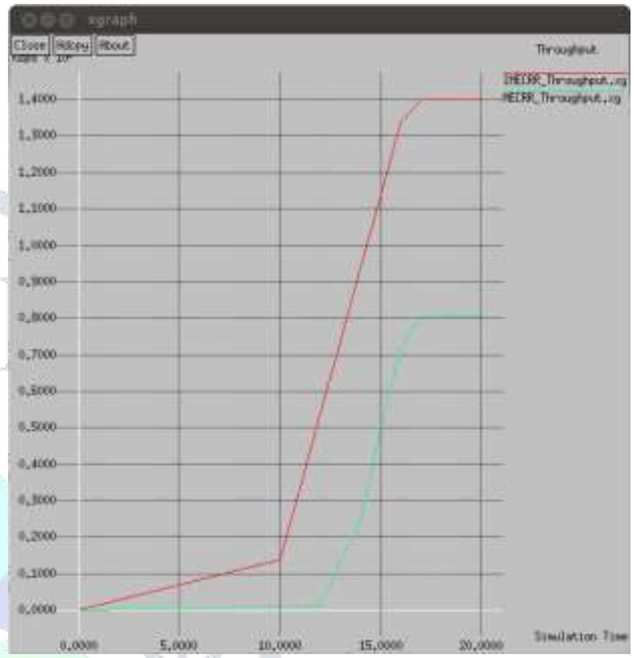

Figure 4.3: Throughput Comparison

The throughput obtained for the proposed scheme was 1400 Kbps and for the existing scheme was 806 Kbps. This indicates destination node receives more data with proposed scheme than the existing scheme.

Parameter\Scheme	Existing	Proposed
Throughput	806 Kbps	1400 Kbps
PDR	45.97	51.13
Routing Overhead	6.59	4.44

Table 4.1: Results comparison

V. CONCLUSION

The proposed scheme aims at reducing the congestion from the ad hoc networks. In this study, we compute congestion according to the value of packet delivery ratio of the path and bandwidth consumed over it. The value of packet delivery ratio which is accurate measure of congestion in the network showed higher value for proposed scheme which indicated the congestion occurred was well taken care of using the proposed scheme. Consequently the value of throughput was also high for the proposed scheme. Since the congestion would cause reduced bandwidth and more packet drops therefore selecting the paths that have less consumed bandwidth and less packet drops have shown improved network performance.

In future, the path selection scheme can further be optimized to reduce energy consumption of the network as this work has not considered energy consumption measure.

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