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Congestion Control Dynamic Queue Management Multipath Routing in MANET

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Abstract: Load balancing is one of the major issues in mobile Ad hoc Network (MANET) because of the frequent changes in topology. Load balancing approach is required to remove the possibility of congestion by that the whole traffic is affected in network. The multipath protocol like AOMDV is able to handle the problem of congestion in network because alternative path is available in network to handle load on a particular link or node but only multipath are not gives the satisfactory results. The queue capacity of nodes is limited in network and if full then in that case the packets are drop it means it requires some more queue size. In this research we proposed a new queue estimation approach of load balancing with AOMDV protocol. In this approach the dynamic queue variation scheme is applied to all nodes in network to improve the storing and forwarding capacity of nodes. If the number of nodes are required the some extra queue length then in that case it is available in proposed scheme. The normal AOMDV protocol are not individual suitable for load balancing that is proved by comparing the result of proposed scheme with normal AOMDV. The actual performance of proposed scheme are improves the 13% network performance as compare to AOMDV.

Keywords: MANET, Multipath, Congestion, AOMDV, Dynamic Queue, Load Balancing

I. INTRODUCTION

Mobile Ad hoc Network (MANET) is a group of wireless mobile nodes with dynamic changing topology forming a temporary network without infrastructure or centralized administration [1]. Mobile Ad hoc Network has turn out to be an active research area in the domain of wireless networking because of their distinctive advantages which includes easier set up, saving in hardware cost [2].

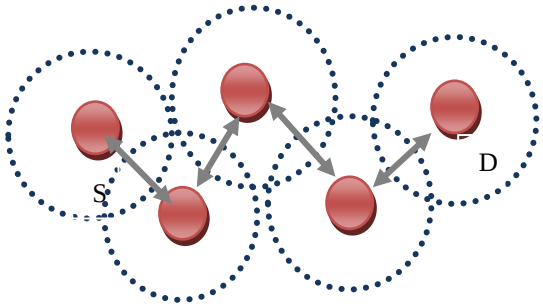

Fig. 1. Mobile Ad hoc Network

Each node can traverse independently in any direction and also act as a router for communication between nodes which are not with in radio distance shown in figure 1. The sender and receiver are represents by S and R. if the sender want to send data in network then first established connection through intermediate nodes after that data delivery will started. The Mobile Ad hoc Network, because of its fast and economically less demanding service, find applications in military, collaborative and distributed computing, emergency operations, wireless mesh networks, wireless sensor networks, hybrid wireless network architectures and educational environments .In MANET privacy of the nodes are ensured by Anonymous communication which also enhances the security of the network [3]. The present work gives idea about the congestion control avoidance in mobile ad hoc networks. Once the Routing protocol is said to be reliable then other issues also should be kept in mind like node behavior and timing delays also. Due to the dynamicity of the link factors there are different issues been observed, in which congestion is one of the problem. Congestion is caused when the offered load to the network is more than the available capacity of network. To overcome the congestion problem in mobile ad hoc network a dynamic queue scheme is suggested in the current work. The queuing mechanism is developed based on the probability of data packets arrived to each node in network. The queuing method hence improves the network metrics such as overall network throughput, reduces the route interruption, overhead and traffic blockage probability. The approach is generated over a routing scheme in ad hoc network.

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II. AOMDV (Ad hoc On Demand Multipath Distance Vector) Routing Protocol

AOMDV [4] offers a multipath, loop-free version of AODV. It ensures that alternating paths at each node are disjoint, therefore achieves path disjointness without using source routing. To support multipath routing, route tables in AOMDV contain a list of incoming paths for each destination. All the paths to a goal have the same destination sequence number. Once a route announcement with a higher sequence number is received, all routes with the old sequence number are removed. Two additional fields, hop count and last hop, are stored in the route entry to help deal with the problems of loop freedom, and path disjointness, respectively. Because the protocol implements multipath innovation, the loop freedom guarantees from AODV no long time delays. AOMDV concentrate on this issue as follows. The hop count field encloses the length of the longest path for a particular destination sequence number, and is only initialized once, at the time of the first announcement for that sequence number. Hence, the hop count remains unmovable until a path for a top destination sequence number is received. It follows that loop self-determination is ensured as long as a node never advertises a route shorter than one already advertised, and never accepts a route longer than one already advertised. To make sure that paths in the route table are link-disjoint, a node discards a path announcement that has either a common next hop or a common last hop as one already in the route table. It was observed that, as extended as all nodes adhere to this rule, all paths for the same destination sequence number are guaranteed to be link-disjoint. Node-disjoint paths can be obtained with an extra restriction that for a picky destination succession figure, each node always advertise the same designated path to other nodes. Route maintenance in AOMDV is similar.

III. Load Balancing in MANET

For improved utilization of the imaginations of the MANET and also to enhance the functioning of the MANET, load balancing technique is used which is the significant tool. Using the load balancing system, the network can condense the traffic congestion and inequity of the load. This is possible because the technique reduces the end-to-end delay, increase the nodes lifetime and optimizes the energy expenditure [5].

The main problem with the existing routing protocols is concerned with the consideration of minimum hop paths as the best path for transmitting the data towards the destination. But the mentioned approach is tiny of communicating the load and path quality while creating the route. The condensed number of deepest nodes turns out to be strength for whole traffic which further causes congestion in medium access control layer (MAC). Therefore it results in improved packet delays as a few nodes possess more loads. There is a possibility that heavily loaded nodes acquire more power utilization which declines the better power. Thus the load imbalance occurs on various routes depreciating the performance causing issues such as congestion, power exhaustion and queuing delay [5].

Consequently, the significance of effective load balancing system is to reduce the variation among overloaded and under-loaded nodes based on workload. The load balancing scheme allocates the traffic among the mobile hosts preventing congestion and exhaustion of resources of congested nodes [6].

IV. Problems occur due to congestion

Congestion lack of knowledge in routing in MANETs may lead to the following problems:

1. **Long delay:** It takes moment for a congestion to be detected by the congestion control mechanism. In strict congestion situations, it may be improved to use a new route. The difficulty with an on-demand routing protocol is the delay it takes to search for the new route.
2. **High overhead:** In case a new route is required, it takes processing and communication effort to discover it. If multi-path routing is used, though an alternate route is readily creating, it takes effort to keep multiple paths.
3. **Many packet losses:** Many packets may have already been lost by the time congestion is detected. A typical congestion control solution will try to reduce the traffic load, either by declining the sending rate at the sender or dropping packets at the intermediate nodes or doing both. The effect is a high packet loss rate or a small throughput at the receiver.
4. **An unbalanced assignment of data traffic:** will lead to power depletion on heavily loaded hosts. With additional hosts powered down, the connectivity of the network will be condensed, which will lead to the failure of calls due to network partitions.

V. Previous Work was Done in this Field

In this paper [7] researchers present a new approach based on multipath routing backbones for better load balancing in MANETs. Nodes in MANETs to a great extent differ with each other in terms of communication and processing abilities. In the designed approach, many routing backbones are recognized from source to destination using intermediary nodes that have better communication and processing capabilities to take part in the mobile routing backbones and proficiently take part in the routing process. In addition to boost load balancing, the new approach also provides enhanced Quality of Service (QoS) support and congestion control according to current network traffic levels and nodes' processing loads.

In [8] authors have proposed an effective system to balance the load in ad hoc network. They used ad hoc on demand multi-path distance vector (AOMDV) for select a path by a lower hop count and discarding the routes with higher hop count.

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They used a threshold value to reviewer whether the intermediate node is overloaded where the threshold value is changing along with the nodes' interface queue occupancy around the backward path.

In this paper [9] has proposed a novel congestion avoidance based load balanced routing with optimal flooding in MANET. Their approach attempts to stay away from the congestion of a node by select the disjoint paths. This is achieved by set a flag bit with the time limit TTL, at the node. On exceeding on this value, the flag bit is reset. Their approach restrictions the flooding and congestion of the node next to with effective balancing of the traffic load. They did not take traffic load and hop count metric into consideration for selecting the route that reduces the network performance.

In this paper [10] a Multipath Rate Based Congestion Control (MRBCC) algorithm is presented. This algorithm, based on the channel utilization percentage and queue length from the intermediate nodes, congestion condition and expected rate are calculated by the destination node. The source behind getting these ethics as a feedback from the destination performs rate control. The MRBCC algorithm has rate valuation and rate controller mechanisms in which the traffic rate is adjusted based on the predictable rate. This rate can be obtained from the intermediate nodes by the destination node which in turn forward this information to the source.

In this paper [11] authors propose congestion controlled adaptive multi-path routing protocol to accomplish load balancing and avoid congestion in MANETs. The algorithm for discovery multi-path routes computes fail-safe multiple paths, which provide all the intermediary nodes on the primary path with multiple routes to a destination. The fail-safe multiple paths comprise the nodes with least load and more battery power and residual energy. When the average load of a node at the side of the route increases away from a threshold, it shares outs the traffic over disjoint multi-path routes to reduce the traffic load on a congested link. Proposed algorithm efficiently resolves the problem of load balancing, network congestion and fault tolerance.

In this paper [12], proposed a node-disjoint multipath routing method (NDMP-AODV) based on ad-hoc on-demand distance vector (AODV) [2] routing protocol. Our proposed methodology lessens the effect of link failure. NDMP-AODV make sure that after a route is broken, the node can continuously send data without any delay, using one of the backup routes stored in its routing table during route discovery process. It has been shown that NDMP-AODV determines multiple paths with a very low routing above as compared to other existing multipath AODV protocols.

In the [13] proposed protocol, predictions are made concerning the overall stability of routing paths based on the relative signal strength of the links, residual energy of node and consistency of node along those paths. Based on these predictions, the various paths are line up so that the most stable path is chosen for routing before any other path. Measure the stability of a route based on the calculated cumulative DVM of the specific links in that route and not on the hop count. This paper delivers a key for this problem with variation in the method of Decision Value metric [DVM] which represent the overall strength of a path, and thus provide a scalable and adaptive multi path routing in MANET.

Authors in [14] propose a scheme to find all node-disjoint paths from source to destination. NDM-AODV also considers the residual energy of nodes while picking the routes. The routing overheads to find multiple paths are kept least by using Destination Source Routing (DSR) protocol like source routing in route discovery process. Periodic HELLO messages are used to keep local connectivity for all lively routes during the route maintenance phase. The main drawback of the proposed approach is that as the size of the network increases, the size of the RREQ and RREP messages also increases due to path accumulation function. Moreover, the size of routing table at destination node also rises due to the storage required to store multiple paths.

In this paper [15], proposed an on-demand routing scheme called Split Multi-path Routing (SMR) that creates and utilizes multiple routes of maximally disjoint paths. As long as multiple routes assist minimizing route recovery process and control message overhead. The protocol uses a per-packet sharing out scheme to distribute data packets into multiple paths of active sessions. This traffic dissemination efficiently utilizes available network resources and prevents nodes of the route from being congested in heavily loaded traffic situations.

VI. PROPOSED ALGORITHM FOR CONGESTION AWARE AND MINIMIZATION

In this section we organize algorithm for congestion aware and minimization, here we set initial variables which is shown the particular character of network. Multipath routing technique of broadcast routing packet are using for data delivery in the network. Routing packet condense with route request packet, source node number and receiver node number and after receiving route packet by any node we identify node number for forwarding the node and route table creation, that broadcast packet comes to the receiver node by more than two routes than we select best three route for data transmission and transmit the data. If any intermediary node processing capability is lesser than the source and receiver and more sender share common intermediate node than congestion is arrive to that particular node so we apply dynamic queue base technique for saving the data at precise node. This technique is improved the storing capacity of nodes by that the packet dropping due to queue are almost negligible. All the work minimizes routing overhead as well as delay and drop from the network.

Step 1: define variable M mobile node's
Step 2: define set of S sender and R receiver
Step 3: Define Routing = AOMDV (Multipath)
Step 4: Queue type = Drop Tail priority Queue

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Step 5: Generate RREQ message for route search
Step 6: Broadcast (RREQ, S, R)
        While (node in range && node! = R)
        {
                Intermediate node;
                Incr sequence++;
                Forward (RREQ, node, R)
                If (node ==R)
                {
                Receiver found;
                Establish Reverse path;
                }
                Else {exit}
        }
Step7: if (Route >=2)
                {
                Select best three out of all paths;
                }
Step8: Send data (data, S, I, R)    // pervious method base
        {
                Check available of Queue in intermediate I node;
                If (Q is full)
                {
                Drop data;
                Analyze data drop with node number;
                        }
                Else {En-queued ;}
        }
Step9: Send data (data, S, I, R)    // proposed method base
        {
                If (Q is full)
                {
                Increment Queue +1;
                En-queued;
        }       }
Step10: Stop
```

VII. Simulation Environment

The simulation is executed in Network Simulator 2.31 [16], a simulator for mobile ad hoc networks. The simulation parameters are providing in Table 1. We implement the random waypoint movement model for the simulation, in which a node starts at a casual position, the simulation interval is 100, and then moves to another random position with a velocity preferred random and maximum up to 30 m/s. A packet proportions of 512 bytes and a transmission rate of 3 packets /s.

TABLE I. Simulation Parameters for Case Study

Examined Protocol	AOMDV
Number of nodes	50
Dimension of simulated area	800×600
Simulation time	50 sec
Radio range	550
Traffic type	CBR, 3pkts/s
Packet size	512 bytes
Number of traffic connections	TCP/UDP
Maximum Speed	30 m/s
Node movement	random

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A. Performance Metrics:

In our simulations we use a number of performance metrics to equate the proposed AODV protocol with the surviving one. The following metrics were well-thought-out for the comparison were:

1) *Throughput:* Number of packages received at destination in per unit of time.

2) *Packet delivery fraction (PDF):* The ratio between the numbers of packets sends by source nodes to the number of packets correctly received by the corresponding destination nodes.

3) *End to End delay:* The average end-to-end delay of data packets is the interval between the data packet generation time and the time when the last bit arrives at the destination.

4) *Normalized routing load:* Measured as the number of routing packs transmitted for each data packet supplied at the destination.

VIII. Simulation Results

In this section the evaluated results are conversed on the basis of normal AOMDV and proposed dynamic queue based AOMDV.

A. Hello Packet Analysis

The Hello Packets analysis is the analysis of control packets that are sending in network for connection establishment in between sender and receiver. These packets are playing the important role in connection establishment procedure and if the receiver is ready for data receiving then sending the connection confirmation packet to sender after that data delivery is started. This graph shows the Hello packets analysis in case of normal AOMDV and Proposed Random Queue based AOMDV schemes. The AOMDV are balance the load in network but not efficiently means some extra is required to reduce the possibilities of congestion then the random queue technique is used for controlling the congestion situation. In case of AOMDV about 6500 packets re deliver in network but in case of proposed scheme about 5700 packets are deliver in network. It means that in case of AOMDV the possibility of retransmission is more as compared to proposed AOMDV.

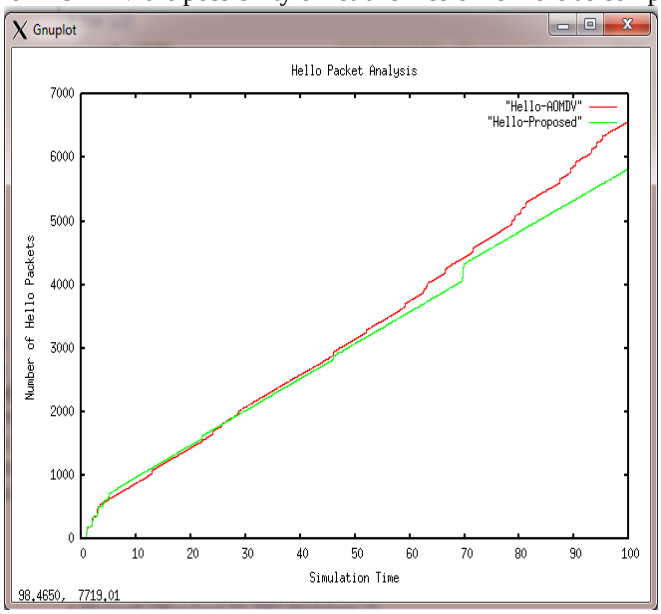

Fig. 2. Hello Packet analysis

B. PDR Analysis

Packet Delivery Ratio (PDR) analysis is the percentage of number of packets successfully received at destination. This graph represents the PDR analysis in case of normal AOMDV and proposed AOMDV. Here we obviously observed that in case of normal AOMDV the PDR are about 58% but in case of proposed scheme the PDR value is about 72% in network. In case of proposed AOMDV the random queue length are applied on each node in network it means the packet storing capacity of nodes in network are enhanced and it handles efficiently data storing and forwarding in network. The normal AOMDV are providing the alternative path on the bases of minimum hop count selection but this path is free or lightly loaded or heavy loaded the sender is not known means there is no idea about the traffic data density but proposed scheme is reduces these overhead and provides better results as compare to normal AOMDV.

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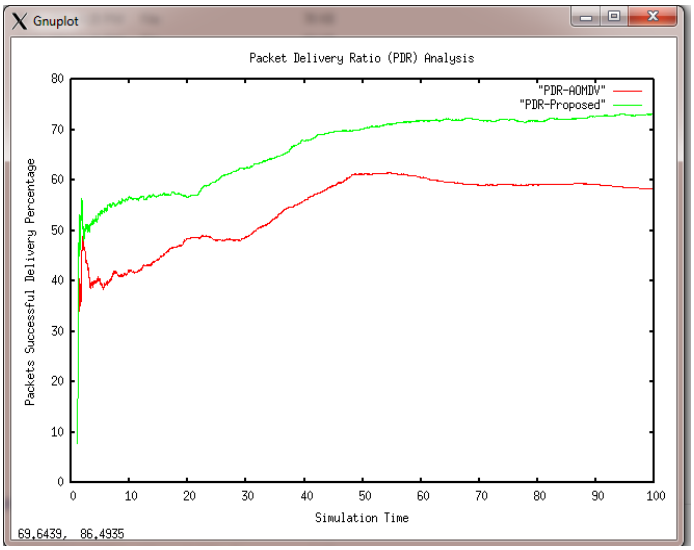

Fig. 3. PDR Analysis

C. Throughput Analysis

Throughput is deliberate on the basis of member of packets are successfully deliver at destination in per unit of time means x packets in one second. This graph is shows the throughput analysis in case of normal AOMDV and proposed dynamic queue based AOMDV routing. The throughput in case of AOMDV is about 900 packets/ second maximum at time interval about 45 to 65 seconds and at the end of simulation the throughput is about 880pakets/ seconds but in case of proposed AOMDV the dynamic queue length scheme are improves the throughput performance. Here about 1100 packets are delivered in network and at the end of simulation the throughput performance is almost identical in every second. The dynamic queue length scheme is efficiently eliminate the prospect of congestion and improves the network performance.

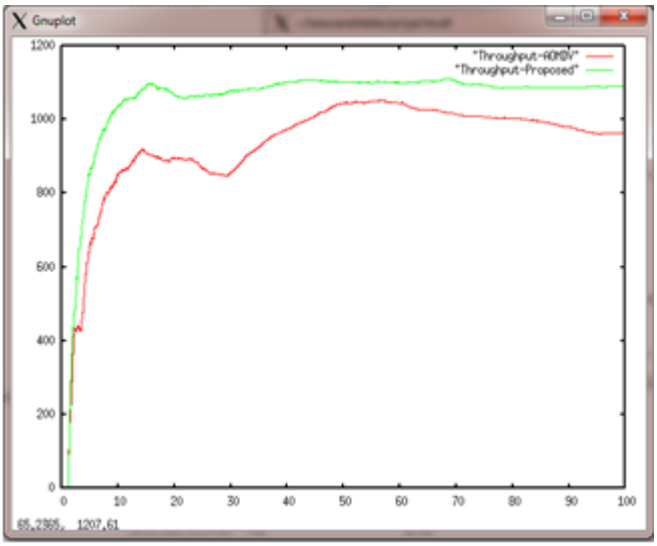

Fig. 4. Throughput Analysis

D. PDR analysis on the basis of Node Mobility

This graph represents the PDR analysis with different speed of nodes in case of normal AOMDV and proposed dynamic queue based AOMDV routing. The simulation is done on the different mobility like 10, 20, 30, 40, 50 and the performance of proposed scheme are showing the better performance in network. The proposed scheme has a capability to handle the load on nodes efficiently. The PDR with increasing mobility in case of old scheme are showing the performance degradation but the proposed scheme is not affected from higher mobility in network. It means that the proposed scheme is not affected by frequent changes in topology and provides the better results.

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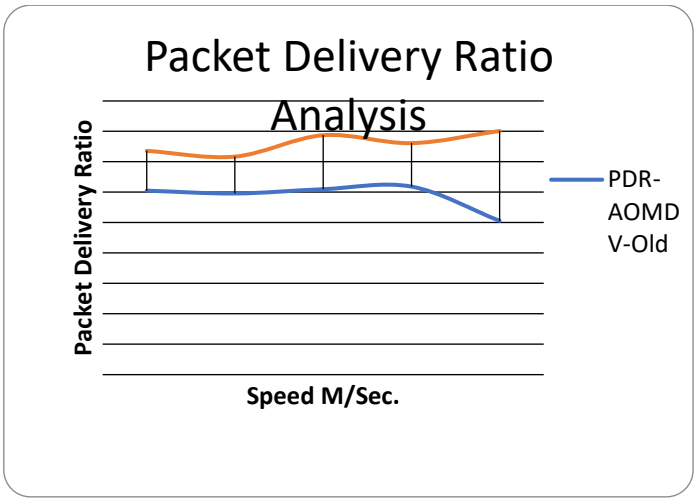

Fig. 5. PDR analysis on the basis of different speed

E. Delay Analysis on the basis of Nodes Mobility

This graph represents the delay analysis in case of normal AOMDV routing (old case) and proposed dynamic queue based AOMDV. The delay in network is measured in milliseconds and the mobility of nodes in meters/seconds. The performance of delay in case of Old AOMDV routing are more because for load balancing the alternate path is choose and again retransmit the data in network. But in case of proposed dynamic queue length based AOMDV the delay is minimized and in case of proposed scheme with respect to higher mobility delay are minimized. It means that dynamic change in topology because of node mobility is not enhanced the delay in network but complete multipath routing with proposed scheme.

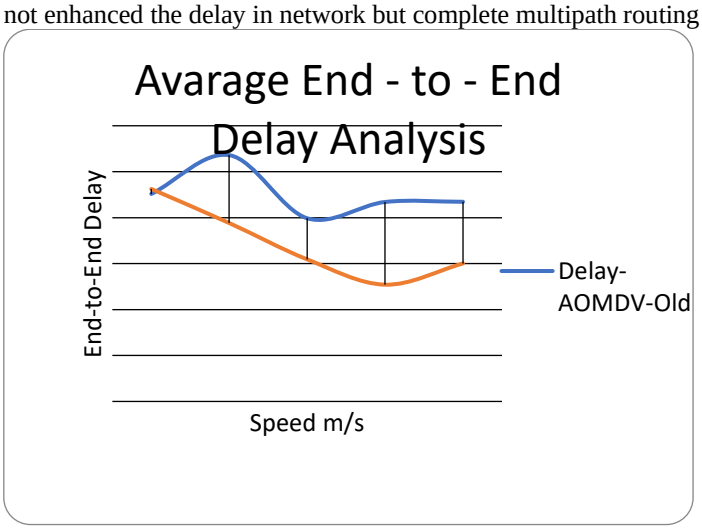

Fig. 6. Delay analysis on the basis of different speed

F. Overall Summary of Simulated Results

The overall summery of normal AOMDV and proposed dynamic queue based AOMDV are mentioned in table 1. The performance metrics are showing the better performance in case of proposed scheme. The actual performance in case of proposed scheme is about 85 % which is about 13% more as compare to normal AOMDV routing.

TABLE II. OVERALL ANALYSIS

PARAMETERS	AOMDV		PROPOSED AOMDV	
SEND	8603		8577	
RECVIEVE	5012		6271	
ROUTINGPKTS	6575		5830	
PDF	58.26		73.11	

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NRL	1.31		0.93	
DROPRTS	98		91	
NO. OF DROPPED DATA	3591		2306	
ACTUAL PERFORMANCE	20190	72.85%	20678	85.20%

IX. CONCLUSION

Congestion has occurred because of heavy data packets delivery between the nodes in network. In MANET the limited bandwidth and frequent change in topology are the major reason of congestion. The load balancing is the one the solution to overcome the problem of congestion. Multipath protocols having a capability of load balancing by proving the alternative path in network. In this paper the proposed dynamic queue based multipath AOMDV protocol are improves the performance of network if compare with normal AOMDV multipath protocol i.e. measured by performance metrics like routing load, throughput delay etc. The proposed dynamic queue length technique has varying the queue size according to incoming data that minimizes the packet loss. Proposed scheme are also provides the better results in case of different nodes speed and at that time the normal AOMDV gives the higher delay and PDR but the proposed scheme are provides the minimum delay and PDR. It means that the higher mobility is also not affected the performance of network in case of proposed scheme.

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