Multipath Congestion Control Advanced Routing to Minimize Packet Dropping in MANET

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Abstract— **The nodes in Mobile Ad hoc Network (MANET) moves freely in network without any supervision of centralized administration. The routing protocol is playing an important role for data sending and receiving in network. The mobile nodes are conversed with other through forming a temporary dynamic network because of that the proficient routing is the major issue in MANET. The available bandwidth in MANET is permanent, that is creating the problem of bottleneck and the network load is increased. In MANET if the congestion is occurring then the performance of network is gradually decreased according to time and also the packet drop is maximizes. No supervision is watch the network activities to handled the occurrence of overcrowding of data packets due to that identified the overloading in dynamic network at the time of routing. In this research we proposed the new congestion control load balancing technique with variation in the buffer size of queue in dynamic network with reliable multipath AOMDV protocol. The AOMDV is also balance the load by given the alternative path but not capable at every condition. The AOMDV is provides the multiple path for data sending, if the one is fail and the fluctuation in queue length is handled the data packets that cross the decided queue limit. The queue is incremented and the storing and forwarding capability of nodes is also improved. The proposed load balancing scheme is well handled the load on the network. If the node being a part of communication moves out of range then the AOMDV is reduced the overhead reestablishment of connection in between sender and receiver. The proposed scheme improves the routing capability of AOMDV protocol. The performance of AOMDV and proposed fluctuation in queue is evaluated through performance metrics and observe the performance of proposed scheme is better.**

Keyword: - MANET, AOMDV, Routing, Load balancing, Fluctuation in queue, Congestion.

I. INTRODUCTION

In wireless network the communication between the various devices is possible through without physical guided media. The wireless network is differentiating into many types like cellular network, sensor network and Mobile Ad hoc Network (MANET. MANET is a network comprising wireless mobile stations that converse with each other without centralized control or established infrastructure. One of the distinctive features of MANET is each node or station must be able to act as a host as well as router to send, receive or find out the optimal path to forward a packet [1] in dynamic network. As the characteristics of MANET nodes are continuously moves in network, at any time entering and leaving the network, the topology of the network will change continuously and unpredictable. MANET provides an promising technology for civilian and military applications were short range communication is required. Since the medium of the communication is wireless, only limited bandwidth is available and not possible to enhance easily same as wired network. In a MANET, each node has an area of control. This is the area or communication range of nodes over which it can be sensed or heard by other neighbor nodes up to destination not found. Network utilization optimization is also an vital research aspect. Unlike wired networks, MANET consists of nodes that have limited power and restricted bandwidth. The special characteristics of MANET nodes cause divergence of efficiency and fairness in routing optimization. Most of the time, these two objectives cannot be simultaneously achieved. Efficiency focuses on delivery of packages using the fastest and shortest path, while fairness tries to distribute the traffic more uniformly across the MANET. A lot of packets are dropped at the same time as excessive amount of packets reach to destination at a network uncertain block of packets condition is occur. The packets dropped would've voyaged long way and in addition the lost packets frequently stimulate the possibility of retransmission. A stream of packet start arriving from multiple sources and all need the same output line. In this case at each node a queue will be built up i.e. the main function of storing and forwarding the data packets, performing by intermediate nodes in dynamic network. If there is insufficient memory to hold all the packets, the packet will be lost because if more incoming of packets w.r.t outgoing of packets. Increasing the memory to unlimited size does not solve the problem of congestion but the proper load balancing added with this is possible to resolve congestion problem. This is because, by the time packets arrive at front of the queue, they have already timed out (as they waited the queue). When timer of packet receiving is out source re-transmits packet that are also added to the queue. Thus same packets are added again and again, increasing the load all the way to the destination. This intimates that even extra packets are sent into the network. And so, network throughput is still more worsening by the network congestion.

There are chances of congestion crumple where almost no data is delivered successfully if no suitable congestion control is performed [2]. The bandwidth of the links between the nodes is not possible to enhance due to that heavy traffic is congested the network. The proper load balancing scheme is required to balance the traffic load of dynamic network by distributing it or improves the processing capability of mobile nodes by confirm the senders to slow down their traffic rate. The protocol ensures that the existing bandwidth in the network is used well by distributing traffic evenly which ensures better load balancing and congestion control [3].

The routing procedure of connection establishment in AOMDV is same as single path AODV routing protocol. Ad-hoc on demand multipath distance vector (AOMDV) [4] selects a path with a lower hop count and discards routes with higher hop count. The new method can be applied in most on demand routing protocols. In this research we use AOMDV protocol with balance queue level of nodes for improving the storing and forwarding capacity of mobile nodes in dynamic network. The proposed method reduces the loss from congestion but not fully removes in network and the AOMDV provides the alternative path if the link is break due to any reason like higher mobility congestion and collision.

II. TYPES OF ROUTING IN MANET

The Routing in a MANET depends on many factors including topology, selection of routers, and initiation of request and specific underlying characteristic that could serve as a heuristic in finding the path quickly and efficiently [1,5]. The highly dynamic nature of these networks imposes severe restrictions on routing protocols specifically designed for them, thus motivating the study of protocols which aim at achieving routing stability.

A. Classification of routing protocols in MANET:-

The MANET routing protocols are completely different from the traditional wired and wireless routing protocols. The different routing strategy of routing protocols can be categorized as Table-driven, source initiated and Hybrid [1, 5]. The three types of protocol functioning are completely different. The overview of three categories of routing protocols is as follows:-

1) Proactive orTable driven routing protocol:-

The proactive or table driven routing protocols are similar to and come as wired networks. In proactive routing, each node has maintained the tables that contain the most recent and previous information of the routes to any node in the network. A variety of table driven protocols diverge in the way the information regarding a change in topology is disseminated through all nodes in the network. The table driven routing protocols are not suitable for larger networks, as they need to maintain node entries for each and every node in the routing table. This is the main reason of overhead in the routing table leading to consume more bandwidth. Examples of such schemes are the conventional routing scheme is Destination Sequenced Distance Vector (DSDV).

2) Reactive or On Demand routing protocol:-

Reactive routing protocols or On demand routing is also known as on demand routing protocol since they don't preserve routing information of previous data delivery. They do not preserve or continuously update their route tables with the latest route topology. If a sender node wants to send a packet to receiver node then this protocol searches for the route in an on-demand manner and establishes the connection in order to transmit and receive the packet through intermediate nodes. The route discovery generally occurs by flooding the route request packets all over the network. Examples of reactive routing protocols are Ad hoc on demand distance vector routing (AODV).

3) Hybrid routing protocol:-

These protocols try to include various features of proactive and reactive routing protocols. They are generally used to afford hierarchical routing; routing in general can be either flat or hierarchical. In a flat approach, the nodes communicate directly with each other. The problem with this is that it does not scale well; it also does not allow for route aggregation of updates. In a hierarchical approach, the nodes are grouped into clusters, within each cluster there is a cluster head, this acts as a gateway to other clusters, it serves as a sort of default route. Example of a hybrid routing protocol is the Zone Routing Protocol (ZRP).

Based on the procedure of liberation of data packets from the source to destination, classification of MANET routing protocols could be done as follows:

- Single path Routing Protocols: In single path method the single path is established in between sender to receiver. The next path availability is only possible if the first one existing path is section is break and also the same procedure of route selection is call again. Multipath Routing Protocols: Multipath routing is a technique that develops the underlying corporal network resources by utilising multiple paths from source to destination. Due to request fails on single route, the process is again started. But in multipath multiple alternate paths are establish until a new route is established.

Multiple paths can also give load balancing and route breakdown protection by distributing traffic among a set of disjoint paths. There are numerous ways to use the multiple paths. In [6, 7] the multiple paths are not used simultaneously. The data packets are transmitted along one path. Other paths are kept as backup paths in case the used one is broken. When all possible paths are broken, a new multipath discovery procedure is initiated again.

III. RELATED WORK IN FIELD OF CONGESTION

There are lot of work was done in field of congestion control load balancing and each work has effective to balance the load. The only some of latest work is as mentioned below.

M. Ali, B. G Stewart et. al.[8] In his work titled "Multipath Routing Backbones for Load Balancing in Mobile Ad Hoc Networks" this title we are discuss a new approach based on multipath routing backbones for enhanced load balancing in MANETs. Nodes in MANETs really differ with each other in terms of communication and processing capabilities. In the proposed method, multiple routing backbones are identified from source to destination using intermediate nodes that have better communication and processing capabilities to take part in the mobile routing backbones and efficiently participate in the routing process. This work use multipath technique but not execute multipath simultaneously in that case use alternative base load balancing technique.

M. Ali et al. [9] have proposed when the average load of an existing link increases beyond a defined threshold and the available bandwidth and residual battery energy decreases below a defined threshold value, then traffic is distributed over fail-safe multiple routes to reduce the traffic load on a congested link. Through simulation results, researchers show that their proposed approach achieves better throughput and packet delivery ratio with reduced delay for constant bit rate (CBR) traffic when compared with QMRB (a protocol using QoS mobile routing backbones)

Soundararajan et. al. in his titled "Adaptive Multipath Routing for Load Balancing in Mobile Ad Hoc Networks" [10] they propose congestion controlled adaptive multi-path routing protocol to achieve load balancing and avoid congestion in MANETs. The algorithm for discovery of multi-path routes computes fail-safe multiple paths, which provide or give every intermediate nodes on the primary path with multiple routes to destination. The fail-safe or reliable many paths include the nodes with least load and more battery power and residual energy. When the average or normal load of nodes along the route increases beyond a threshold then Node distributes the traffic over disjoint multipath routes to reduce the traffic load on a congested link.

Makoto Ikeda, Elis Kulla et. al.[6] "Congestion Control for Multi-flow Traffic in Wireless Mobile Ad-hoc Networks" In this title, researcher deal with congestion control for multi-flow traffic in wireless mobile ad-hoc networks (MANET) using OLSR routing. The OLSR is the Optimized Link State proactive routing This approach done through OLSR routing they also apply multi flow in AODV routing approach.

Fubao Yang in [11] proposed work on title Network Coding-based AOMDV Routing in MANET. This paper proposes a Network Coding-based AOMDV routing algorithm in MANET (NC-AOMDV). It is typically proposed in order to increase the reliability of data

transmission, and by applying network coding, which allows packet encoding at a relay node. Because the encoding packet is generated by a relay node, the source node does not need to encode the packets, and sends only data packets to each route.

Nitin Goel, et.al. in [12] proposed Efficient Weighted innovative Routing Protocol (EWIRP) to Balance Load in Mobile Ad Hoc Networks (MANETs). The EWiRP proposed in this paper is a load balancing technique which can also be viewed as an efficient routing approach, improves delivery ratio, reduces end to end delay, efficiently exploits the resources like available bandwidth, node energy, queue space, without affecting the network's vital assets. The weight computation process considers not only the necessary parameters but also the service classes of the network.

S. Soundararajan et.al in [13] proposed Multipath Load Balancing & Rate Based Congestion Control for Mobile Ad Hoc Networks (MANET).This paper presents a new approach Multipath Load Balancing and Rate Based Congestion Control (MLBRBCC) based on rate control mechanism for avoiding congestion in network communication flows. In this technique the destination node copies the estimated rate from the intermediate nodes and the feedback is forwarded to the sender through an acknowledgement packet. Since the sending rate is adjusted based on the estimated rate, this technique is better than the traditional congestion control technique.

Shalini Puri, Dr. Satish. R. Devene, in [14] proposed "Congestion Avoidance and Load Balancing in AODV Multipath The proposed protocol (AODV-Multipath) preserves the higher hop count routes in the routing table and utilizes it as alternate path as link failure occurs. AOMDV does not provide any means to avoid congestion and load balancing in the network. Queue Length detects congestion in the network. Queue Length and Hop Count value are together used to select a route from source to destination that avoids congestion and load balancing.

Tuan Anh Le [15] in his work titled "ecMTCP: An Energy-Aware Congestion Control Algorithm for Multipath TCP" they build up an energy-aware congestion control algorithm for multipath TCP, called ecMTCP (energy congestion multipath TCP). In ecMTCP moves traffic from the high congested paths to the more lightly loaded paths, as well as from higher energy cost paths to the lower ones, that node achieving load-balancing and energy-savings. In this title, they develop ecMTCP. This title focus congestion control with the help of energy base load balancing mechanism, this work also modified via multipath routing technique for end-to-end delay minimization.

IV. Proposed Congestion Control Scheme

The multipath protocol is able to handle the congestion by providing the alternative route in between sender and receiver in dynamic network. The main reason is that if the routing performance is not improved by multipath routing protocol that means switching to alternative path is more frequently happening in dynamic network then in that case it is required to apply some new approach to bulged congestion. To handle the data in dynamic network it is necessary to provides the extra memory to nodes for storing packets coming beyond the limit of queue defining in simulation. The proposed novel algorithm for bulged congestion is proposed in this research.

In proposed algorithm for congestion aware and minimization, here we set initial variables are show the particular character in network. Multipath routing technique of broadcast routing packet are using for data delivery. Routing packet encapsulate 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 generation, that broadcast packet comes to the receiver node by more than one route, than we select best three route for data transmission and transmit the data. If any intermediate node processing capability is lower than the source and receiver and more sender share common intermediate node than congestion problem occur to that particular node so we apply dynamic queue base technique for saving the data at that node. This technique is enhanced 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 Initialize Mobile Node: M
Step 2 Initialize sender: S where S belong M
Step 3 Initialize sender: R where R belong M
Step 4 Terrain Size: 800*800 Meter
Step 5 Initialize Queue Drop Tail
Step 6 Initialize Antenna: Omni Antenna
Step 7 Initialize MAC: 802.11
Step 8 Initialize Routing: AOMDV
Step 9 Initialize Radio Range (RR) = 250 meters
Step 10 Sender Broadcast RREQ (S, R, Radio Range)

```
If (Next-hop in Range && Channel ==idle)
{
Receives RREQ;
While (node in range && node! = R)
{
        Intermediate node;
        Increment sequence++;
        Forward (RREQ, node, R)
        If (The Next Node = = R)
        {
                Receiver found;
                Established path;
        }
        Else if (next-hop in range && channel ==        busy)
{
 Wait next RTT (Round Trip Time)
}
Else
        {
```

```
        Receiver not found
                        }
Step11: If (Route >=2)
                {
                Select best three out of all paths;
                }
Step12: Send data (data, S, I, R)    // pervious method base
    {
    Check available of Queue in intermediate I node;
    If (Q = = Packets Full)
    {
    Drop all upcoming data packets;
    Analyze data drop of each node;
                        }
    Else {enqueued ;} // in case of not capacity required in queue
    }
Step13: Send data (data, S, I, R)    // proposed method base
    {
                If (Q = = Packets Full)
                {
                Increment Queue by 1 ;
                En queued Packets ;
                }
    }
Step14: Stop
```

The source node forwards the data packet to the destination through the intermediate nodes. On reception of the data packet at the intermediate node, percentage queue length is estimated and node is verified for congestion status. This process is repeated at every intermediate node, and finally the packet reaches the destination node. The queue length method is applied in each node with AOMDV multipath routing protocol. The use of multipath routing is to provide the alternative path, if the any intermediate node in a session is congested the immediately the information of that link is deliver to sender then the sender will select the next alternative path to deliver data. On the whole proposed load balancing scheme is required to perform following actions:

- For choosing non-congested paths or to distribute excessive load of a node to its neighbor
- Improving the resource usage
- To minimize the end-to-end delay and packet losses caused by queue overflow.
- Check the estimates length of queue.
- Enhancing the network performance and minimizes collision by the distribution of load.

V. Description of Simulation Tool

After The NS network simulator [61, 62], from U.C. Berkeley/LBNL, is a object-oriented discrete event simulator targeted at networking research and available as *public domain*. Its first version (NS-1) Instigate or begin in 1989 as a variant of the REAL network simulator and was developed by the Network Research Group at the Lawrence Berkeley National Laboratory (LBNL), USA. Its development was then part of the VINT project [16], sustained by DARPA, at LBNL, Xerox PARC, and UCB, cover by which NS version 2.0 (NS-2) was released, increase substantially from the first version. The aim of the VINT was not to design a new network simulator, but to link the effort of all people working in the research field of network simulation. The result is that NS-2 is widely used in the networking research community and has found large acceptance as a tool to experiment new concept, protocols and distributed algorithms. Currently NS-2 development is also supported through DARPA. NS-2 is used mostly for small scale simulations of queuing and routing algorithms, congestion control, transport protocols, and part of multicast related work.

A. Simulation Parameters

The NS-2 simulator is installed in windows 7 with the help of supporting *Cygwin* software in MANET. The practical implementation of MANET is not possible at current time so that the whole work on MANET is done in simulation software.

table 1 simulation parameter

Number of nodes	10, 20, 30, 40, 50
Dimension of simulated area	800×600
Routing Protocol	AOMDV
Simulation time (seconds)	100
Transport Layer	TCP ,UDP
Traffic type	CBR , FTP
Packet size (bytes)	1000
Number of traffic connections	10
Maximum Speed (m/s)	Random

B. Performance Measure

We have primarily selected the following parameters in order to study the performance of our proposed technique

- **The Packet Delivery Ratio:** is defined as the number of received data packets divided by the number of sends data packets (it's also percentage of data delivery in receiver end).
- **End to End delay:** It is the time taken for a packet to be transmitted from the source node to the destination node (that measure in seconds).
- **Routing packets:** The total number of routing packets transmitted that is also called routing overhead because number of routing packet broadcast before communication established.
- **Dropped Data Packets:** -The number of data packets that are not successfully sent to the destination but actual transmitted by sender node.

We also apply number of various extra network parameters and measure the result of our proposed work.

VI. Simulation Results Evaluation and Explanation

The following simulation results are evaluated on the basis of performance metrics is described in this section.

A. PDR Performance Analysis

Packet delivery ratio is the ratio of the packet that are successfully delivered to the destination compared to the no. of packet that are sent by the sender. The Packet Delivery Ratio analysis is the total study of the packet delivery ratio of all the scenarios. The analysis shows the design point with changing parameters in X axis compared with probability of the packets delivered to the destination in those different scenarios. There five different scenarios with changing no. of nodes. The result analysis shows two different conditions existing and proposed. The red line in the graph shows the probability of the packet delivery ratio with five different scenarios in existing module. The green line in the graph shows the probability of the packet delivery ratio with five different scenarios in proposed module. Comparing the existing module with proposed module there is slight variation in the results but the proposed has the higher packet delivery ration as compared to the existing module.

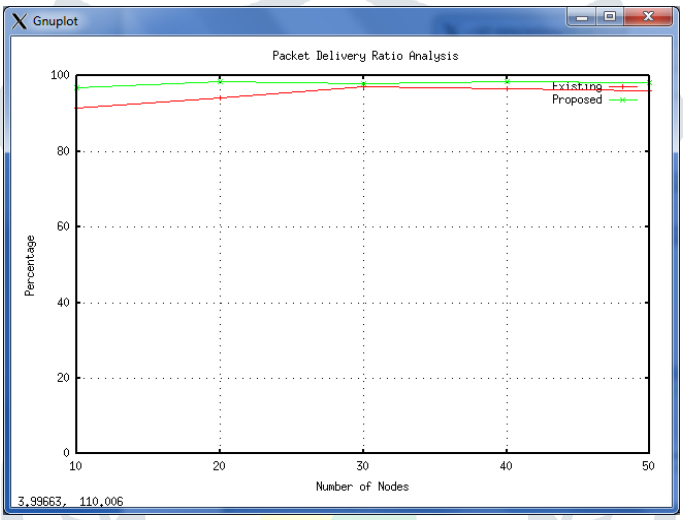

figure1 pdr performance analysis

B. Routing Packets Flooding Analysis

The routing packets in network is flooded i.e. route request and route reply packets. The sender is flooded the route request packets and receives route reply packets till the destination is not found in network. In this graph the routing packets flooded analysis in case of proposed scheme and normal routing is evaluated and finds that the number of routing packets flooding in case of normal routing is more that is the sign of excessive link breakage and retransmission of data packets in different nodes density scenario. The proposed routing performance is better and minimizes routing packets flooding in network.

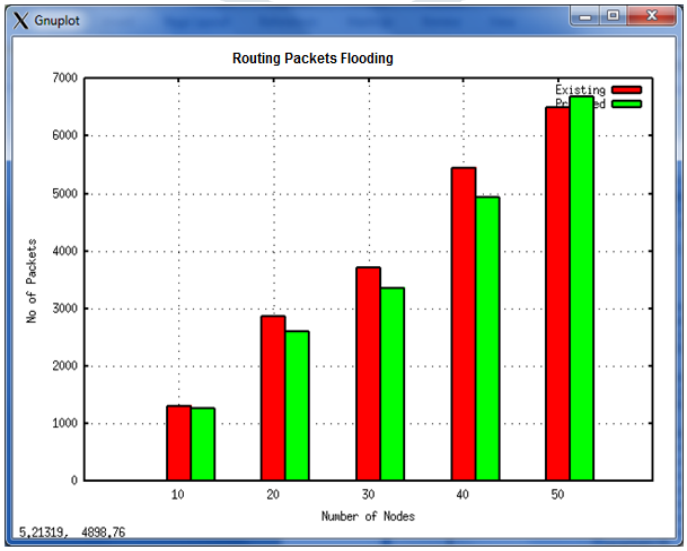

figure2 routing packets flooding analysis

C. Routing Load Analysis

The normalized routing load is defined as the number of routing packets transmitted per data packet received at the destination. The result analysis shows that the packet receives per seconds for the five different design points. The existing condition is represented by the red line shows that the throughput for the network is low. The proposed methodology is represented by the green line in the graph. The normalized routing load for the proposed is less as compare to normal in different nodes density scenario.

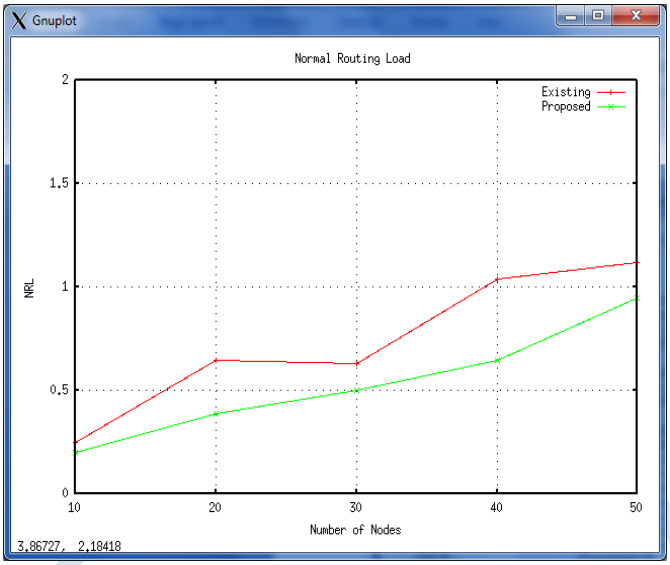

figure 3 routing load analysis

D. Throughput Analysis

The number of packets is received at destination in per unit of time are measured the through throughput parameter. The throughput is higher in network, if the transmission and receiving are running continually without any hindrance like jamming and congestion. The result analysis shows that the packet receives per seconds for the five different design points. The existing condition is represented by the red line shows that the throughput for the network is low. The proposed methodology is represented by the green line in the graph. The throughput for the proposed methodology is greater than the other two conditions. This shows the proposed methodology work with less hindrance in the network. The overall analyses represents that the performance of the proposed methodology is better than the old and jamming condition.

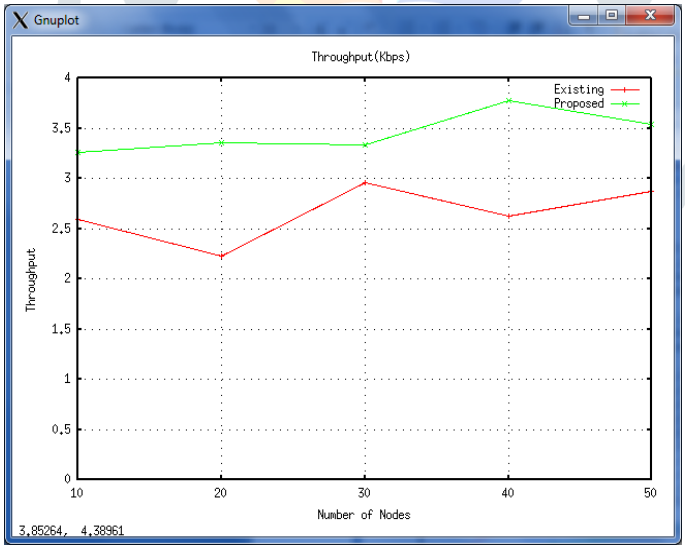

figure 4 throughput analysis

E. End to End Delay Analysis

The end to end delay is the average time taken by the data packet to reach to the destination. The delay caused by route discovery process and the queue in the data packet transmission is also counted. The data packets that are successfully delivered to destination are only counted. The average end to end analysis is the comparison of the five different design points. As in the graph the existing network is represented by the red line showing the average end to end delay for five different design points. The proposed condition is represented by the green line in the graph. The proposed methodology has less ends to tend delay as compared to the existing condition.

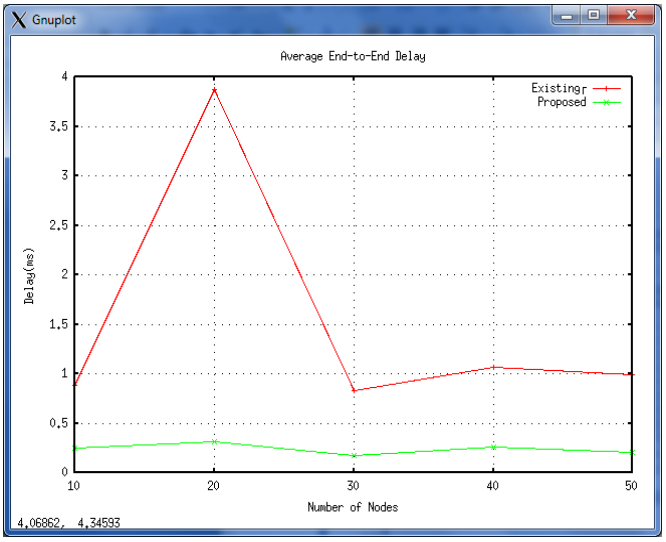

figure 5 end to end delay analysis

VII. Conclusion and Future Work

In open dynamic network it is not sure at how much time the connectivity of between the sender and receiver is maintained. The bandwidth in wireless MANET is limited and the enhancement in bandwidth is not possible easily extended in MANET as compare to traditional wired network. Congestion control involves the design of mechanisms and algorithms to statistically limit the demand-capacity mismatch, or dynamically control traffic sources when such a mismatch occurs. To balance load the proposed In order to maintain good network performance, certain mechanisms must be provided to prevent the network from being congested for any significant period of time. The proposed fluctuation in queue length based load balancing congestion control scheme is reduces the delay, overhead and packet drop in dynamic Network. The AOMDV protocol is able to handled load by providing alternative path if the already established path is congested. The proposed scheme is improves the load balancing by providing the required queue size to each node in network. Due to that the processing ability of nodes are also utilized for maximum data forwarding to next neighbor and receiving from neighbor or sender. The proposed load balancing scheme is much better than normal AOMDV protocol. The simulation a result of AOMDV and Proposed congestion control scheme is evaluated through performance metrics and the proposed scheme is improves the data receiving, throughput and PDF.

The location discloser is also the one the main issue in MANET and also the number of nodes are not mentioned their current location information. In future advancement maintain the location information without apply any GPS (Global Positioning System).

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