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Congestion Control Load Balancing Scheme Intended for Improving Performance of MANET

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Abstract—***the availability bandwidth in MANET is fixed, that is creating the problem of bottleneck and the load in network is increased. In MANET if the congestion is occur then the performance of network is gradually decreased according to time. In this research we proposed the new congestion control load balancing technique with varying the buffer size of queue in dynamic network with reliable multipath AOMDV protocol. The multipath routing protocol AOMDV is also balance the load by providing alternative path but not capable at all situation. The AOMDV is provides the multiple path for data sending, if the one is fail and the varying queue length is handled the data packets that cross the decided queue maximum. The queue is incremented and the storing and forwarding capability of nodes is also improved. The proposed load balancing proposal is proficiently handled the load on the network. If the node being a component of communication is moves out of range then the AOMDV is reduced the overhead and re-establishment of connection in between sender and receiver. The proposed method is increase the routing capability of AOMDV protocol. The achievement of AOMDV and proposed varying queue is evaluated through performance metrics and observe the performance of proposed scheme is better.***

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

1. INTRODUCTION

Mobile Ad hoc Network (MANET) is a network comprising wireless mobile nodes (MNs) that communicate with each other without centralized control or established infrastructure. One of the unique features of MANET is each node must be able to act as a router to find out the optimal path to forward a packet [1]. As nodes may be mobile, entering and leaving the network, the topology of the network will change continuously. MANET provides an emerging technology for civilian and military applications. Because the medium of the communication is wireless, only limited bandwidth is presented. In a MANET, no such infrastructure exists and the network topology may dynamically change in an unpredictable manner since nodes are free to move in a neighboring areas. Network utilization optimization is also an important research aspect. Unlike wired networks, MANET consists of nodes that have limited power and restricted bandwidth. The particular characteristics of MANET nodes cause conflicts of efficiency and fairness in routing optimization. Most of the time, these two objectives cannot be concurrently achieved. Performance focuses on delivery of data packages using the fastest and shortest path, while justice tries to share out the traffic more regularly across the MANET. A lot of packets are dropped at the same time as excessive amount of packets arrive at a network stumbling block. The packets dropped would've voyaged long way and in accumulation the lost packets frequently activate the possibility of retransmission. A stream of packet begins arriving from multiple sources and the entire need the same output Chanel. In this case, a queue will be developing. If there is not enough memory to hold every the packets, the packet will be lost. Increasing the memory to limitless size does not resolve the 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 goes off sender broadcast duplicate packet that are also added to the queue. Thus similar data packets are computed again and again, increasing the load or amount all the way to the destination node. This intimates that even more packets are sent into the network. And so, network throughput is still more deteriorating 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 available bandwidth in the network is utilised efficiently by distributing traffic evenly which ensures better load balancing and congestion control [3].

Ad-hoc on demand multipath distance vector (AOMDV) [4] selects a path with a lower hop count and discards routes with superior hop count. The novel scheme 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 approach is reduces the loss from congestion but not completely removes in network and the AOMDV is provides the alternative path if the link is break due to any reason like higher mobility etc.

2. 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:-

According to the routing strategy the routing protocols can be categorized as Table-driven, source initiated and Hybrid [1, 5] while depending on the network structure these are classified as flat routing, hierarchical routing and geographic position assisted routing based on the routing strategy the routing protocols can be classified into three parts:

2.1 Proactive (Table driven) routing protocol:-

In proactive routing, each node has one or more tables that contain the latest information of the routes to any node in the network. Different table driven protocols differ in the way the information about a change in topology is propagated through all nodes in the network. The proactive protocols are not suitable for bigger networks, while they require maintaining node entries for all and every node in the routing table of every node. This cause additional overhead in the routing table leading to consumption of more bandwidth. Examples of such design are the conventional routing schemes, Destination Sequenced Distance Vector (DSDV).

2.2 Reactive (On-Demand) routing protocol:-

Reactive routing is also known as on demand routing protocol since they don't maintain routing information. They do not maintain or constantly update their route tables with the latest route topology. If a node requests to send a packet to a different 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. The route detection generally occurs by flooding technique the route request packets during the network. Examples of this routing protocols are the dynamic source Routing (DSR), ad hoc on-demand distance vector routing (AODV).

2.3 Hybrid routing protocol:-

These protocols try to incorporate various aspects of proactive and reactive routing protocols. They are commonly used to present hierarchical routing; routing in general can be both flat and hierarchical. In a flat routing approach, the nodes communicate directly with each other. The problem with this is that it does not range well; it also does not allow for route aggregation of update. In a hierarchical routing, the nodes are grouped into clusters, inside each cluster there is a cluster head, this proceed 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 method of delivery of data packets from the source to destination, categorization of MANET routing protocols could be done as follows:

- Single path Routing Protocols: The routing protocols that consider sending information packets to a single destination from a single source. Alternate path is selected in terms of first one break from any reason.
- 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 provide load balancing and route failure protection by distributing traffic among a set of disjoint paths. There are several ways to use the multiple paths. In [6, 7] the multiple paths are not used simultaneously. The data packets are transmitted next to one path. Other paths are kept as backup paths in case of used path are broken. After all possible paths are broken; a recent multipath discovery procedure is initiated again.

3. 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 this paper researcher present "Multipath Routing Backbones for Load Balancing in Mobile Ad Hoc Networks" in 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 approach or 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 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 and R. S. Bhuvaneswaran [10] In his titled "Adaptive Multipath Routing for Load Balancing in Mobile Ad Hoc Networks" they suggest 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 (normal) load of a node along the route increases beyond a threshold, then Node distributes the traffic over disjoint multi-path to reduce the traffic load on a congested link.

Makoto Ikeda, Elis Kulla [6] "Congestion Control for Multi-flow Traffic in Wireless Mobile Ad-hoc Networks" In this paper, researcher agreement 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 et al. [11] proposed work on title Network Coding-based AOMDV Routing in MANET. This paper presents 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 communicate node. Because the encoding packet is generated by a relay node, the sender node does not require encoding the packets, and sends only data packets to each route.

Nitin Goel et al. [12] in this paper 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 packet delivery ratio, reduces end to end delay, efficiently exploits the resources like presented bandwidth, node energy, queue buffer, without affecting the network's vital assets. The weight calculation procedure considers not only the necessary parameters but also the service classes of the network.

S. Soundararajan and R. S. Bhuvaneswaran [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 message or communication flows. In this procedure the receiver node copies the estimated rate from the intermediate nodes and the feedback is forwarded to the sender through an acknowledgement packet. Because the sending rate is familiar (adjusted) based on the estimated rate, this procedure is better than the conventional congestion control technique.

Shalini Puri, Dr. Satish, R. Devene, [14] in this paper 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 arise. AOMDV does not present any means to avoid congestion and load balancing in the network. Queue Length identifies congestion in the network. Queue Length and Hop Count value are jointly used to select a route from source to destination that avoids congestion and load balancing.

Tuan Anh Le et al. [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 routes, further from superior energy cost routes to the lower ones, that node achieving load-balancing and energy-savings. In this title, they build up 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.

4. PROPOSED CONGESTION CONTROL SCHEME

In the MANET (Mobile Ad hoc Network) important challenge in congestion control mechanism because how the sender know about network congestion and adjust the rate, so our objective to work in the challenging field of congestion control for minimization waiting time as well as dropping of data packet and we design an congestion control with load balancing using multipath routing mechanism in mobile ad-hoc network, so that we eliminate or reduce congestion as well as we can minimize routing overhead of the network and also increase the packet delivery ratio of the network. For that reason we will propose Congestion control with load balancing using AOMDV routing in MANET. Effective load balancing has been a complicated task in Mobile Ad hoc Networks (MANET) due to their dynamic and un-predictable behaviour and topology change. This examine presents a new approach based on multipath routing for enhanced load balancing in MANET. Nodes in MANET greatly differ with each other in terms of communication and processing capabilities. In the proposed technique, multiple routing path 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.

Our proposed will ensure that there will be no dropping of packets in the network through the congestion and hence ensure that there will be successful data transfer with lowest overhead required. Our work applies in MANET environment and achieve following goal as well as scope This work efficiently gives congestion information of network to the sender, than sender node adjust our rate or alternative path for data delivery so congestion can't occur, it's provide the load of each node that means (load aware technique) that module minimize the waiting time of data because according to load sender set the rate and deliver the data, our work real time applicable for minimizing data drop from the network if MANET implemented.

Algorithm for congestion Aware and Minimization

In this work we deploy 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 is arrive to that particular node so we apply dynamic queue base technique for saving the data at particular 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 since 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 (m)
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
        {
Go to step 10;
        }
Step11: If (Route >=2)
        {
        Select best three out of all paths;
        }
Step12: Send data (data, S, I, R)
        {
        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 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
```

Importance of the research work

Our research proposal is important for following purpose

- Our proposal work under the mobile ad-hoc environment with dynamic nature that cases our module control congestion and provide best data delivery.
- In our propose work under the multipath routing strategies so that provides fast and congestion free communication with load balance base.
- It's provides reliable as well as low overhead and increases throughput of the network.

Our proposed method also minimizes the end-to-end delay because multipath routing protocol provides data delivery through more than one path bases.

5. DESCRIPTION OF SIMULATION TOOL

After The NS network simulator [16, 17], from U.C. Berkeley/LBNL, is an 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 expansion was then part of the VINT assignment [16], persistent by at LBNL, DARPA, Xerox PARC, and UCB, cover up by which NS version 2.0 (NS-2) was released; increase significantly from the first version. The aim of the VINT was not to design a new network simulator, but to association the effort of all people working in the research field of network simulation. Network simulator (NS-2) result is extensively used in the networking research area and has found large acceptance as a tool to experiment new concept, distributed algorithms and protocol. Presently NS-2 progress is also maintained 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	50
Dimension of simulated area	800×800
Routing Protocol	AOMDV
Simulation time (seconds)	100
Transport Layer	TCP ,UDP
Traffic type	CBR , FTP
Packet size (bytes)	1000
Number of traffic connections	6
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

3 **Packet Delivery Ratio:** is describing 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).

4 **Average Throughput**: It is the average number of messages successfully delivered per second.

5 **Routing packets:** The total number of routing packets transmitted that is also called routing overhead because number of routing packet broadcast before communication established.

6 Packet Drop Reasons: - The packet data packets drop reasons is may in dynamic network like congestion, queue length, collision and call back. The congestion is not possible to eliminate from network completely but minimization is possible.

We furthermore apply number of various additional network parameters and measure the result of our proposed work.

6. SIMULATION RESULTS EVALUATION AND EXPLANATION

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

6.1 PDR Performance Analysis

The congestion is degrades the network performance by jam the link in between sender to receiver or the link in between two nodes i.e. hop. Congestion lower the data processing capability of mobiles nodes because of that data receiving and forwarding is not properly managed in dynamic network. The PDF performance is depend on the percentage of receiving and sending. If the difference in data packets sending and receiving is more, then PDF reduces. In this graph the PDF

performance of normal AOMDV routing is more up to simulation time 50 seconds but after that due to congestion network performance is continues reduces up to end of simulation. The proposed varying queue length load balancing scheme properly balance the load and improves network performance in terms of PDR metrics. The proposed PDR at initial not degrades network performance but the receiving sending ratio of end to end (TCP + UDP) is little bit less and it is actually due to TCP end packets getting (receiving).

Fig.1 PDR Analysis

6.2 Throughput Performance Analysis

The congestion is reduces the data traffic forwarding and receiving in network due to unavailability of bandwidth capacity. The limited link bandwidth is not capable to handled extra load of packets that is the main causes of data packets loss in dynamic network. The throughput of normal AOMDV protocol is to much less is about highest 275 packets/seconds at time about 11 seconds and after that the throughput is continuously degrades in network. The only multipath protocol is not able to handle the congestion situation in dynamic network. The proposed varying queue length load balancing technique is improves the throughput by reduces the congestion loss. The proposed load balancing scheme is provides the maximum 500 packets/seconds up to end of simulation. The proposed throughput represents the communication between the mobile nodes in dynamic network.

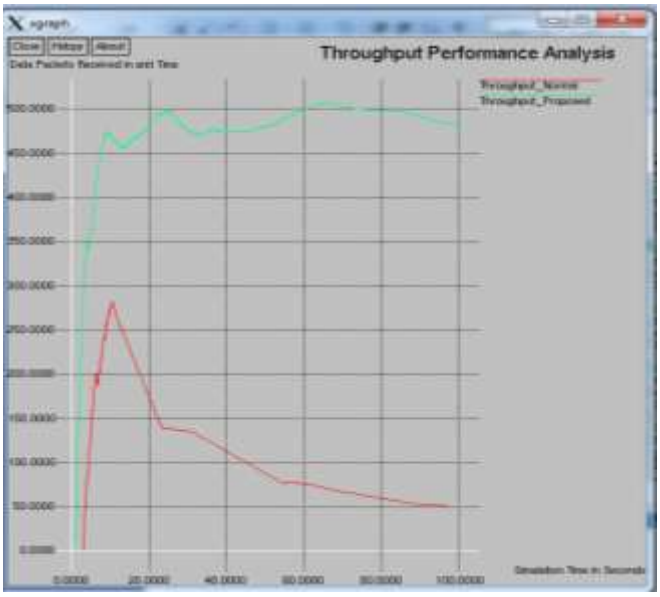

Fig. 2 Throughput Analysis

6.3 Routing Overhead Performance Analysis

The connection loss due to congestion is reduces the packets receiving at destination side and improves the data loss. If the packets are loss or their limited link expiration time is out then in that case the query of reestablishment of connection is generated starting sender side, this is the main source of routing packets or routing capacity enhancement. The routing load is considered with respect to data packets received in given simulation time. The delivery of more routing packets is the sigh of reestablishment of connection. The routing packets reckoning of normal AOMDV is about 7250 packets but the routing packets reckoning of proposed queue length load balancing congestion control technique is less about 6250 packets. The receiving in less routing packets is more in proposed scheme but normal AOMDV is less.

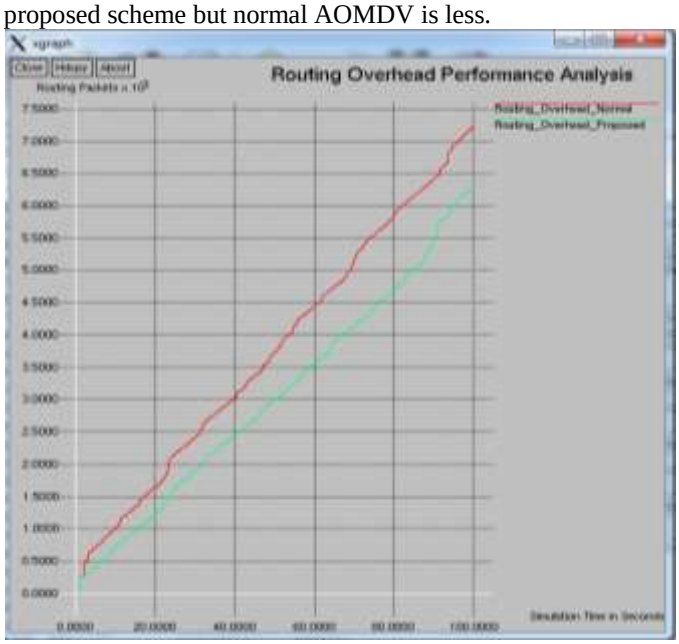

Fig. 3 Routing Overhead Analysis

6.4 Performance Analysis of AOMDV Normal and Proposed Queue based AOMDV

The congestion in network indicates that the mobile nodes are not handled load properly in network. The sender and receiver organization of data is necessary for communication

and reduce the possibility of congestion. The proposed method of load balancing is minimizes the packet loss due to congestion and other factors. The Table 2 is shows the performance of normal AOMDV routing and proposed queue length based AOMDV routing. The proposed load balancing scheme is improves about 14% network performance and reduces packer loss in dynamic network.

Table 2. Performance of AOMDV Normal and AOMDV Proposed

Performance Metrics	AOMDV Normal	Actual perfor-mance	AOMDV Proposed	Actual Perfor-mance
SEND	9756		11244	
RECV	6493		8528	
ROUTING PKTS	7227		6290	
PDF	66.55		75.84	
NRL	1.11		0.74	
DROPRTS	75		43	
No. of dropped data	3263		2716	
Actual Performance	23476	78.53%	26062	89.46%

6.5 Drop Reason Analysis of AOMDV Normal and Proposed Queue based AOMDV

The data is drop in MANET has many reasons like out of range, congestion, collision, Queue length (IFQ) and No Route exist (NRT). The proposer link connectivity is the main challenge in MANET and this is not overcome easily. The Table 3 is shows the different packet dropping reasons. The packet loss due to congestion in proposed varying queue length load balancing scheme is reduces as compare to normal AOMDV. The packets dropping due to queue length is zero in proposed load balancing scheme but in normal AOMDV is very high.

Table 3. Packet Drop Analysis

Drop Reason	AOMDV	% Drop	Proposed	%Drop Proposed
Drop from IFQ	2416	8.08%	0	0.00%
Drop from CBK	431	1.44%	100	0.34%
Drop from NRT	195	0.65%	190	0.65%
Drop from ARP	38	0.13%	20	0.07%
Total Drop Via Congestion	3338	11.17%	2759	9.47%
Total Drop	6418	21.47%	3069	10.54%

7 CONCLUSION AND FUTURE WORK

Congestion control involves the design of mechanisms and algorithms to statistically limit the demand-capacity variance, or dynamically control traffic sources when such a variance occurs. To balance load the proposed In order to maintain good network performance, confident mechanisms must be provided to prevent or restrict the network from being congested for any significant period of time. The proposed varying queue length based load balancing congestion control scheme is reduces the delay, routing overhead and packet drop in dynamic Network. The AOMDV protocol is capable 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 capability 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, PDF and throughput.

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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