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Load Aware and Load Balancing using AOMDV Routing in MANET

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***Abstract*--Effective load balancing has been a demanding task in MANET due to their dynamic and un-predictable nature and topology change. Nodes in MANETs greatly differ with each other in terms of communication and processing power. For effective working of MANET 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. In addition to improved load balancing, the new method also provides enhanced Quality of Service (QoS) support and congestion control as per existing network traffic levels and nodes' processing loads. In this paper we are going to propose a Load aware and load balancing techniques using multipath routing.**

***Keywords:* - AODV, DREAM, QoS, Routing Load, Packet Delivery Ratio.**

1. INTRODUCTION

Mobile ad hoc network (MANET) is a group of mobile nodes where each node is free to move about arbitrarily. Each node logically contains a router that may have multiple hosts and that also may have multiple wireless communication devices. A MANET is self organizing, adaptive and infrastructure less; AODV currently does not support Quality of Service (QoS) and also has no load balancing mechanism. The QoS routing feature is important in a stand-alone multi hop mobile network for real-time applications and also for a mobile network to interconnect wired networks with QoS support. The first extension (named QoS field) specifies the service requirements (maximum delay is chosen), which must be met by nodes rebroadcasting a Route Request or returning a Route Reply for a destination. A comprehensive packet-layer simulation model through media access control (MAC) and physical layer models is used to study the performance of both the AODV and the QoS-AODV protocols. We extend the ns-2 (network simulator version 2) to include the proposed QoS-AODV protocol, delay constraints, topological rate of change and mobility speeds. A multicast packet is delivered to all the receivers belong to a group along a network structure such as tree or mesh that is constructed once a multicast group is created. However because of node mobility the network structure is brittle and thus, the multicast packet may not be delivered to some members. To recompense this problem and to get better packet delivery ratio, multicast protocols for ad-hoc networks usually employ control packets to periodically refresh the network structure.

1.1 Routing in MANETs

Routing protocols for MANETs are dynamic in nature and require each node to store routing information about destinations that are needed to be reached and also update that information as the network topology changes. A significant number of routing protocols have been suggested for these networks.

1.1.1 Position-based routing protocols

These protocols make the routing decisions based on nodes‟ geographical coordinates. Each node maintains an updated location table that contains the geographical position of all its neighbours. The routing decisions are made based on the neighbours‟ coordinates and trajectory information towards the destination location. Two of the position based protocols are Simple Forwarding over Trajectory (SIFT) and Distance Routing Effect Algorithm for Mobility (DREAM).

1.1.2 Topology-based routing protocols

Classical routing approaches for MANETs are topology-based in which the routing decisions are based on links among network nodes. In other words, these protocols are link-driven. A routing table is maintained which contains the route to destinations and an existing link pointing towards it. If a node moves resulting in a link break then the route needs to be recomputed. These protocols can further be classified as Table-driven or Proactive, Source-initiated (On demand) or Reactive and Hybrid routing protocols.

1.1.3 Table-driven routing protocols

Proactive routing protocols monitor the topology of the network at all times and pre-compute paths between any source and destination. Routes are maintained for all nodes, even for nodes to which no data has been sent. This is done by periodically exchanging routing tables throughout the network, similar to traditional wired networks. These protocols maintain tables at each node which stores updated routing information for every node to every other node within the network. An advantage of these routing protocols is that obtaining the required route information and establishing a session will not be time-consuming. A disadvantage of these routing protocols is that it will react to topology changes even when no traffic is affected by that change, which is extremely resource-consuming and will result in the unnecessary usage of bandwidth even when no data is transferred. Another drawback is more power consumption due to periodic exchange of information. Examples of such protocols are Destination-Sequenced Distance-Vector Routing protocol (DSDV), Optimized Link State Routing (OLSR), Cluster head Gateway Switch Routing (CGSR) protocol, The Wireless Routing Protocol (WRP).

1.1.4 On-demand routing protocols

Reactive routing protocols find a route only when there is a demand for data transmission, i.e., at the beginning of a connection. In other words, the route discovery process begins whenever a source node needs a route to a destination in on-demand routing. A route between two hosts is determined only when there is an explicit need to forward packets. This is done by initiating a route discovery within the network by flooding the entire network with route request (RREQ) packets. Also, once a route is established, it is maintained in the routing table until the destination is out overhead is significantly reduced, since the routing information does not have to be updated periodically, and no maintenance is done on routes that are not being used. One disadvantage of these protocols is the latency that occurs when a route is required. However, for highly mobile networks, these protocols show better performance for MANETs. Few examples of such protocols are Ad Hoc On-Demand Distance Vector (AODV) routing protocol, Dynamic Source Routing (DSR) protocol, Temporally Ordered Routing Algorithm (TORA) and Associativity-Based Routing (ABR).

1.1.5 Hybrid routing protocols

On-demand routing has relatively less routing overhead, since it eliminates periodic flooding of the network with update messages. But it suffers high routing delay when compared to table-driven routing. Table driven routing ensures high quality in static topologies but cannot be extended to mobile networks. Combining the advantages of both, a few hybrid routing protocols have been designed, whereby the routing is first initiated with some proactive routes and then serves the demand from other nodes through reactive flooding. Zone Routing protocol (ZRP) is one of the protocols that falls under this category. Since both bandwidth and power are limited in mobile networks, on-demand routing protocols are more widely used then table-driven routing protocols. Among all proposed on-demand routing protocols, AODV and DSR are most commonly used protocols. The author uses AODV in this thesis for experimentation purposes.

1.2 Load Balancing in MANETs

In traditional wired networks, load balancing can be defined as a methodology to distribute or divide the traffic load evenly across two or more network nodes in order to mediate the communication and also achieve redundancy in case one of the links fails. The other advantages of load balancing can be optimal resource utilization, increased throughput, and lesser overload. The load can also be unequally distributed over multiple links by manipulating the path cost involved. On the other hand, the objective of load-balancing in MANETs is different from that of wired networks due to mobility and limited resources like bandwidth, transmission range and power. In mobile ad hoc networks, balancing the load can evenly distribute the traffic over the network and prevent early expiration of overloaded nodes due to excessive power consumption in forwarding packets. It can also allow an appropriate usage of the available network resources. The existing ad-hoc routing protocols do not have a mechanism to convey the load information to the neighbours and cannot evenly distribute the load in the network. It remains a major drawback in MANETs that the nodes cannot support load balancing among different routes over the network.

1.3 Need of Load Balancing in MANETS

On-demand routing protocols such as AODV initiate the route discovery only if the current topology changes and the current routes are not available. In high mobility situations where the topology is highly dynamic, existing links may break quickly. It may be safe to assume that in such scenarios the on-demand routing protocols like AODV and DSR can achieve load balancing effect automatically by searching for new routes and using different intermediate nodes to forward traffic. Whereas, in the scenarios where the same intermediate nodes are used for longer period of time, the on-demand behaviour may create bottlenecks and cause network degradation due to congestion and lead to long delays. In addition, the caching mechanism in most on-demand routing protocols for intermediate nodes to reply from cache, can cause concentration of load on certain nodes. It had been shown in [1] that the increase in traffic load degrades the network performance in MANETs. In other words, if the topology changes are minimal then this behaviour results in same routes being used for a longer period of time which in turn increases the traffic concentration on specific intermediate nodes. It had been proved in [2] that the congestion and the delay in delivering packets are increased with the decreased mobility in on-demand routing. In addition, it also increases the energy consumption at intermediate nodes and has them expire early. This early expiration of nodes can cause an increase in the control packets and the transmission power of other nodes to compensate the loss. Furthermore, it can result in network degradation and even an early expiration of the entire ad-hoc network. Besides, using a same node for routing traffic for a longer duration may result in an uneven usage of the available network resources, like bandwidth. A network is less reliable if the load among network nodes is not well balanced.

2. RELATED WORK

Several protocols have been developed for supporting ad hoc multicast routing, i.e. MAODV [3] [4], ODMRP [5], and CAMP [6]. However, these protocols did not address the QoS aspects of ad hoc wireless communication. Only a few protocols support QoS in multicast routing in mobile ad hoc networks. Examples are QAMNet [7], QMR [8], E-QMR [9] and Lantern-trees [10]. The QAMNet [7] approach extends the mesh-based ODMRP multicast routing protocol by introducing traffic prioritization, distributed resource probing and admission control mechanisms to provide QoS. For available bandwidth estimation, it compared the threshold rate of real-time traffic and current rate of real-time traffic. This is the same as method of SWAN [11]. Similarly, it has many difficulties to estimate the threshold rate accurately because of its dependence to the traffic pattern. A lantern-tree topology is used to provide QoS multicast routing in [10]. This protocol shares time slots at the Mac layer and uses a CDMA over TDMA channel model. In this model, available bandwidth is measured in terms of the amount of free slots. At start up, it shares time slots between all neighbour nodes and finds a suitable scheduling of the free slots. Its main disadvantage is the need for a centralized MAC scheme in ad-hoc mobile networks with dynamic wireless environments. M. Ali et al. [12] have proposed a QoS aware routing protocol employing multi path routing backbones using intermediate nodes which are rich in resources like bandwidth, processing power, residual energy etc. The protocol ensures that the available bandwidth in the network is utilised efficiently by distributing traffic evenly across multiple routing backbones. Reddy and Raghavan [13] have proposed a scalable multipath on-demand routing protocol (SMORT), which reduces the routing overhead incurred in recovering from route breaks, by using secondary paths. Though it provides fail-safe multiple paths, it does not consider the individual QoS characteristics of the nodes like bandwidth, energy, load etc. A. Tsirigos, Z. J Hass [14] have found that, under certain constraints on the path failure probabilities, the probability of successful communication of packets between source and destination increases with number of paths used and can, in the limit, approach 100 percent. They have proposed a multipath scheme which finds the optimal way to fragment and then distribute the packets to the paths so that the probability of reconstructing the original information at the destination is maximised. Marina and Das [15] have proposed the multipath version of the AODV protocol called AOMDV. It is designed primarily for highly dynamic ad hoc networks where frequent link failures and route breaks occur. With multiple redundant paths, new route discovery is needed only when all paths to the destination fail, unlike AODV where a new route discovery is needed in response to every route break. The AOMDV algorithm finds multiple loop free link disjoint routes from source to destination in the MANET. AOMDV performs better in terms of delay, routing load and route discovery time compared to the single path AODV. However these multiple paths need not satisfy the QoS requirements of the flow as the intermediate nodes taking part in the multiple paths are not selected based on their ability to support the QoS requirements. Ivascu et al. [16] have presented an approach based on mobile routing backbone (MRB) for supporting QoS in MANETs. Their QMRB-AODV protocol identifies the nodes which have capabilities and characteristics that will enable them to take part in the MRB and efficiently participate in the routing process. Their approach improves network throughput and packet delivery ratio by directing traffic through lowly congested regions of the network that are rich in resources. To build routing backbones, they classify the nodes in the network based on their characteristics as either QoS routing nodes, simple routing nodes that route packets without any QoS guarantee or transceiver nodes. However since only a single MRB is identified between a source and destination, frequent route breaks may happen in highly dynamics networks leading to more frequent route re-discovery processes and hence increased overheads.

3. PROPOSED METHOD

3.1 Problem Definition

In the field of mobile ad hoc networks routing protocols, there are lot of problems to be tackled such as Quality of service, routing optimization and security issues. My main interest is in the security issues related to routing protocols in MANETs. The work is done through Network simulator-2 and measures network performance. Our aim to minimize congestion using multipath routing with load aware technique that provide low overhead and increases performance of the network like throughput, packet delivery ratio and also minimize average end-to-end delay.

3.2 Proposed Work

3.2.1 Proposed methodology

According to problem statement , very first we create mobile node and very first routing protocol as AOMDV (Ad-hoc on demand multipath distance vector routing) after next time we apply LAR routing for destination expected zone finding and set channel type as wireless channel , prorogation type two ray ground wave because mobile node contain routing table and also node radio range is limited so our data transmitted from node to node after that we apply MAC (media access control technique) as 802.11 WLAN that provides radio range as our dissertation work proposed in Enhance AOMDV with location aided routing and control the congestion as well as balance the load of the network here we describe LAR working scheme and the define proposed algorithm.

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3.2.2 Working of LAR with respect to Location Tracking System

Our first scheme uses a request zone that is rectangular in shape (refer to figure 4). Assume that node S knows that node D was at location (Xd, Yd) at time t0. At time t1, node S initiates a new route discovery for destination D. We assume that node S also knows the average speed v with which D can move. Using this, node S defines the expected zone at time t1 to be the circle of radius R = v (t1 □ t0) cantered at location (Xd, Yd). (As stated before, instead of the average speed, v may be chosen to be the maximum speed or some other function of the speed distribution.) In position-based routing, a Location-Aided Routing, LAR [75] protocol is a position-based routing protocol that discovers routes to destinations reactively. It uses location information to reduce the routing overhead caused by the route discovery process. Its main concept is to confine the propagation area of the route request (RREQ) messages to the geographical zone that leads to the destination node. For this reason, LAR defines two zones: expected zone and request zone. The expected zone, illustrated in Figure 2, is the circle where the destination node is expected to be located.

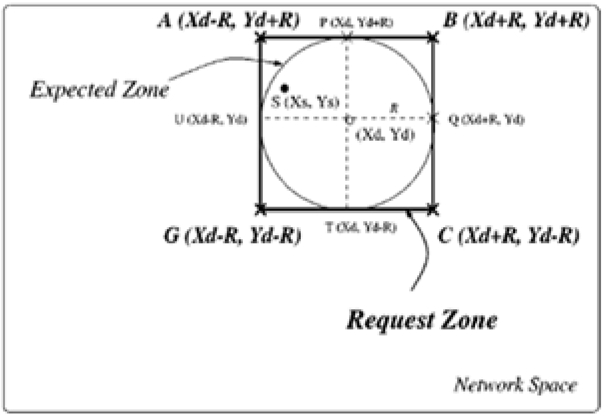

Fig: 1 LAR request and expected zones

The source node, only, broadcasts the discovery request within the request zone, which is the smallest rectangle formed by the expected zone and the source node's position. Furthermore, LAR defines two schemes: scheme-1 and scheme-2. The difference resides in the way the request zone is specified within the request message. In the scheme-1, the source node explicitly specifies the request zone by including the coordinates of the zone's four corners in the RREQ. The receivers located outside the specified rectangle discards the RREQ. On the other hand, in scheme-2, the source node includes in the RREQ the destination's coordinates as well as its distance, Dists, to the destination. The receiving nodes will then calculate their distance to the destination node, and only the nodes whose distance is greater than Dists will forward the RREQ.

3.3 Proposed Algorithm

Here we design algorithm for Enhance AOMDV with location aware routing under MANET, in algorithm very first we create sender and receiver node's and configure routing protocol to each node as AOMDV, that routing protocol uses alternative path means each communication uses two path name as incoming and outgoing path that balance the load of all existing path and uses equal priority base resource after that in internal module we add location aware routing that provide estimated location of destination to the source that LAR protocol minimize routing overhead because every communication failure case routing packet broadcasted by the sender node but the our LAR module minimize routing broadcasting to all direction into only specific estimated location direction. in external TCL (tool command language) very first we set initial network parameter like physical parameter, MAC protocol channel type, antenna type and routing protocol after that we create mobile node with sender and receiver node and routing as AOMDV after that compute route function call and discover route from source to destination on the bases of shortest path for transmissions and alternative path for acknowledge incoming into the sender node, if route break in certain time so route function repetitive call and broadcast route packet that increases route overhead so we use LAR (location aware routing) that module is very use full for route overhead minimization, that case receiver node send location information to the sender node time to time manner and useful for route discovery process and route packet flood only expected zone on the bases of previous location table, here we deploy algorithm step by step in below.

```
Mobile node = N; // Number of mobile nodes
Sender node = S; // sub set of N
Receiver Node = R; //sub Set of N
Receiver Routing = LAR; // Location aware routing
Start simulation time = t0
Set routing protocol = AOMDV;
Set MAC = 802.11
Set radio range = rr; //initialize radio range
RREQ_B(S, R, rr)

{
        If ((rr<=550) && (next hop >0))
        {
                Compute route ()
                        {
                        rtable->insert (rtable-
                        >rt_nexthop); // nexthop to
                        RREQ source
                        rtable1->insert (rtable1-
                        >rt_nexthop); // nexthop to
                        RREQ destination
                        if (dest==true)
```

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{send ack to source node with rtable1; Data_packet_send (s_no, nexthop, type, rtable)

Receiver R uses LAR routing;
Receiver send expected location and speed information to sender;

If (node updates location)
{
Use location info and sender send routing packet to expected zone;
If (dest == true)
{
Data_packet_send (s_no, nexthop, type)
}
}}
else {
destination not found;
}
}
else {destination un-reachable;
} }

3.3 Proposed Working Architecture

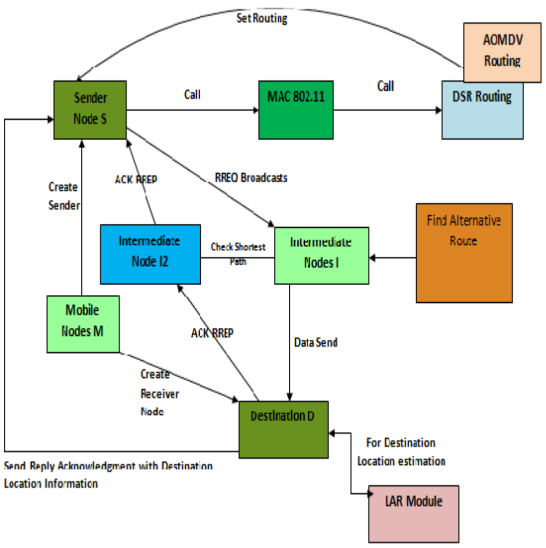

Fig: 2 Proposed working architecture

In above structure present working architecture of our proposed model, basically our module divides into three part internal structure, intermediate and output result format, very firs we explain about internal structure of NS-2, initially we deploy node and apply routing protocol as AOMDV, after that in internal module we inbuilt MAC as 802.11 scheme for that purpose we updated internal file Make. in, ns-lib.tcl, packet.h and cmutrace.cc after that we add third and important part of routing minimization that is LAR module and same above procedure follow if all the module successfully compile and cerate object file than we work in intermediate structure, in that case we create mobile node through the TCL (tool command language) and set mobile ad-hoc network basic parameter here we also apply initial energy of each node, LAR (location aware routing) for destination location aware and routing protocol as DSR and MAC as 802.11 that create the radio range of the node's. in this module sender node initiate routing discovery process so sender use as AOMDV routing and broadcast routing protocol and same time we also search alternative path for acknowledgment sending that minimize congestion in one existing path but node change self-position and break the communication link than LAR module are work important role for re-establishing of route from source to destination that uses expected zone base route broadcast technique and minimize routing overhead after that we analyse our result through generated trace file and apply third or output module that case we pass output generated trace file into awk (abstract window tool kit) and analyse the result of our proposed work and conclude.

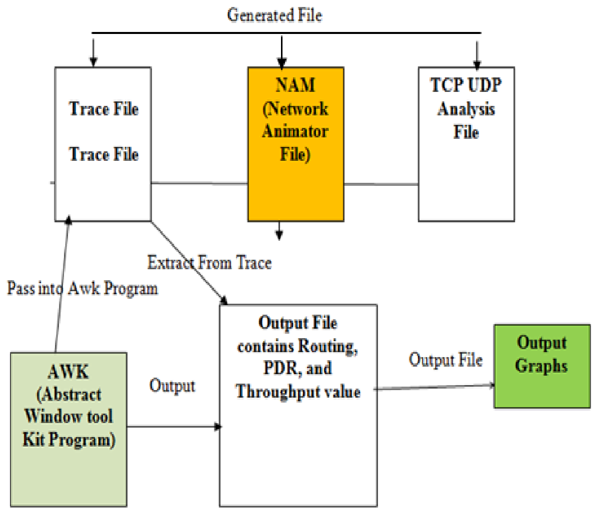

Fig: 3 Proposed working architecture

4. RESULT ANALYSIS

4.1 Simulation Environment

The detailed simulation model is based on network simulator-2 (ver-2.31), is used in the evaluation. The NS instructions can be used to define the topology structure of the network and the motion mode of the nodes, to configure the service source and the receiver etc.

4.2 Data Collection and Implementation Strategy

For data collection and implementation we will use Network Simulator-2 (NS-2). The description about simulation environment is as follows: Network simulator 2 (NS2) is the result of an on-going effort of research and development that is administrated by researchers at Berkeley [17]. It is a discrete event simulator targeted at

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networking research. It provides extensive support for simulation of TCP, routing, and multipath protocol. The simulator is written in C++ and a script language called OTcl2. Ns use an OTcl interpreter towards the user. This means that user writes an OTcl script that defines the network (number of nodes, links), the traffic in the network (sources, destinations, type of traffic) and which protocols it will use. This script is used by ns during the simulations. The result obtained from the simulations is an output file known as trace file that can be used to doing data processing (throughput, calculate delay etc) and to visualize the simulation with a program called Network Animator.

4.3 Basic Simulator Architecture

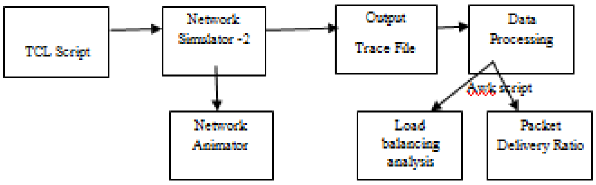

Fig: Basic simulator architecture

4.4 Simulation Parameter

We get Simulator Parameter like Number of nodes, Dimension, Routing protocol, traffic etc. According to below table 1 we simulate our network.

Table 1: Simulation Parameter

Number of nodes	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

4.5 Performance Evaluation

There are following different performance metrics have showed the results on the basis of following: Routing overhead: This metric describes how many routing packets for route discovery and route maintenance need to be sent so as to propagate the data packets. Average Delay: This metric represents average end-to-end delay and indicates how long it took for a packet to travel from the source to the application layer of the destination. It is measured in seconds. Throughput: This metric represents the total number of bits forwarded to higher layers per second. It is measured in bps. It can also be defined as the total amount of data a receiver actually receives from sender divided by the time taken by the receiver to obtain the last packet. Packet Delivery Ratio: The ratio between the amount of incoming data packets and actually received data packets.

4.6 Results

This section represents the results that are calculated on the basis of simulation parameters

4.6.1 TCP Analysis

In this simulation Two TCP connection with TCP normal AOMDV case and TCP at Enhanced AOMDV (with load balancing) were created and analyze the comparative result between them. In given graph result shows x-coordinate as simulation time in seconds and y-coordinate represents window size, according to result output it is observed that maximum window size which TCP normal AOMDV case reached 33 units and TCP E-AOMDV reached maximum 60 units in data transfer. According to simulation result it is observed that the performance of TCP E-AOMDV is much higher.

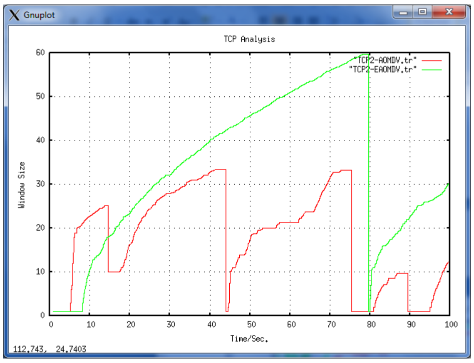

Fig: 4 TCP Analyses

4.6.2 Packet Delivery Ratio Analysis

Packet delivery fraction (ratio) is a ratio of no of receives packets from no of packets transmitted per time unit. According to graph shown below, PDF of normal AOMDV case shown by red line and PDF of Enhanced AOMDV (E-AOMDV) case shown with green line As per result obtained higher PDF value of Normal AOMDV case is nearly 96 % and higher PDF value of E-AOMDV case is nearly 99 %. As per graph E-AOMDV approach shows better result than normal AOMDV.

4.6.3 Routing Load Analysis

Routing load is calculated as the total number routing packets are transmitted over the successful data transmission. The increase in the routing load reduces the performance of the ad-hoc network as it consumes portions from the bandwidth available to transfer data between the nodes. As per graph shown, it is observed that routing load of normal AOMDV time (shown in Red line) was higher than enhanced E-AOMDV time (shown in Green line). Hence according to routing load analysis it is clear that E-AOMDV is better than normal AOMDV.

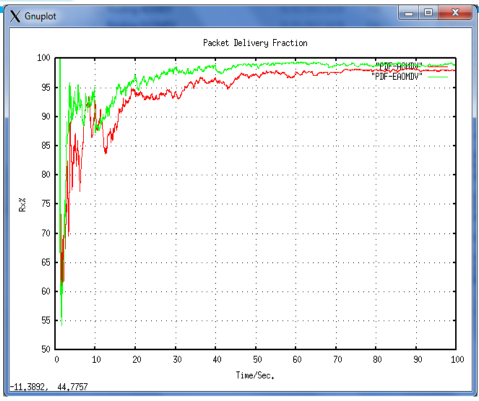

Fig: 5 Packet Delivery Ration Analyses

4.6.4 *Throughput Analysis*

In wireless communication networks, such as packet radio, throughput or network throughput is the average rate of successful message delivery over a communication channel.

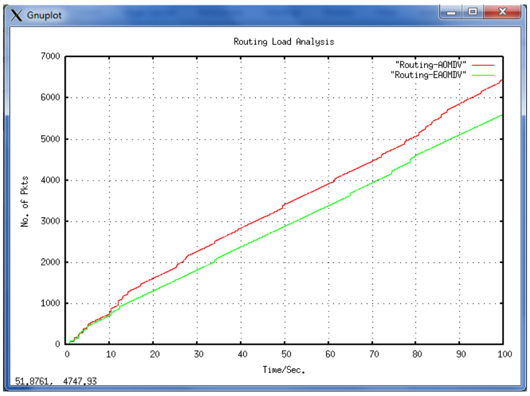

Fig: 6 Routing Load Analysis

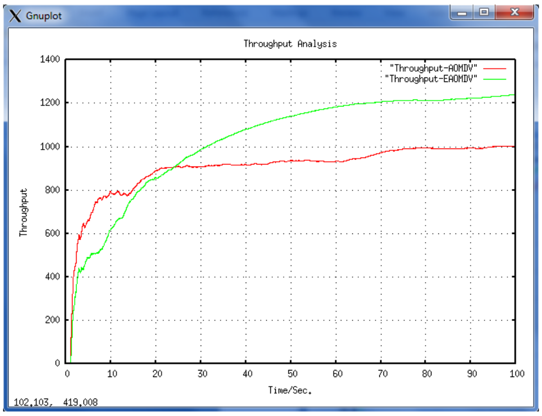

Fig: 7 Throughput Analyses.

This data may be delivered over a logical or physical link, or pass through a certain wireless network node. The throughput is regularly measured in bits per second (bit/s or bps), and occasionally in data packets per second or data packets per time slot. In this graph it is observe that in normal AOMDV and E-AOMDV time, throughput value of normal AOMDV is nearly 900. And throughput of E-AOMDV is 1300 maximum. E-AOMDV gives better result than normal AOMDV time.

5. *CONCLUSION AND FUTURE WORK*

In this paper we proposed Load aware and load balancing using AOMDV routing in MANET. In this work we are going to design an efficient system for load aware routing protocol with load balancing mechanism using AOMDV routing in mobile ad-hoc network, so that we can minimize routing overhead of the network and also increase the life time of the network. As per simulation result enhanced or load balanced E-AOMDV is better than normal AOMDV. Here we analyze AOMDV and E-AODMV in future we also work in the field of secruity constrant under MANET.

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