Queue Length based Load Balancing Technique using with AOMDV Protocol in MANET

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Abstract— Routing in Mobile Ad hoc Network (MANET) is the challenging issue because of their dynamic topology. The multipath routing are definitely providing the reliable communication and mechanism of alternate path if first break but effective load balancing has a demanding task in MANET due to their dynamic and un-predictable nature. 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 this paper we proposed a new approach of load balancing. In this technique queue length based estimation routing with multipath routing AOMDV protocol are used for communication between the sender and destination. In addition to improved load balancing, the new method also provides enhanced support and congestion control as per existing network traffic levels and nodes processing loads.This propose queue length based load balancing techniques using multipath AOMDV routing are provides the imrovement in routing as compare to normal AOMDV. The simulation has done in ns-2 simulator and performance metrics are showing the better results in case proposed scheme.

Key words— MANET, Load balancing, Queue length, AOMDV, Routing

1 Introduction

MOBILE Ad hoc Network are autonomous, self-organized wireless and mobile networks. They do not require any fixed infrastructure such as base stations to operate. The nodes themselves address topology changes due to the mobility and to the arrival and departure of nodes from the network.Each mobile node in an ad hoc network moves arbitrarily and acts as both a router and a host [1]. A wireless ad-hoc network consists of a collection of mobile nodes that are capable of communicating with each other without help from a fixed infrastructure. The interconnections between nodes are capable of changing on a continual and arbitrary basis. Nodes within each other's radio range communicate directly via wireless links, while those that are far apart use other nodes as relays. Nodes usually share the same physical media; they transmit and acquire signals at the same frequency band. However, due to their inherent characteristics of dynamic topology and lack of centralized management security therefore routing in MANET is the challenging task.

In a MANET environment, communication links are unstable due to various reasons such as interference of radio signal, radio channel contention, mobility of the nodes and battery depletion. The wireless network have limited bandwidth and are more prone to error than wired networks which further impose limits on the amount of data that can be sent. Hence, in order to conserve the limited resources, it is highly desirable that transmission should be as efficient as possible (minimal loss) [2]. The main objective of congestion control is to limit the delay and buffer overflow caused by network congestion and provide better performance of the network.

In mobile wireless ad hoc networks the key issue is network congestion and traffic blocking. The congestion occurs in mobile ad hoc networks due to limited availability of resources. The packet transmission in these networks experience interference and fading owing to shared wireless channel and dynamic topology. The network is loaded because of transmission errors. The multimedia communication in MANET is developing with increased demand in recent times. Real time traffic lead to high bandwidth and it results in congestion. Further, congestion causes [3] packet losses and bandwidth degradation and hence can waste time and resoueces on congestion recovery.

2 About AOMDV

AOMDV (on-demand, multipath distance vector routing protocol) is a routing protocol specially designed for MANET environment. On demand multipath protocols discover multiple paths between the source and the destination in a single route discovery. So, a new route discovery is needed only when all these paths fail [4]. AOMDV extends the AODV protocol to discover multiple paths between the source and the destination in every route discovery. Multiple paths so computed are guaranteed to be loop-free and disjoint. AOMDV has three novel aspects compared to other on-demand multipath protocols. First, it does not have high inter-nodal coordination overheads. Second, it ensures disjointness of alternate routes via distributed computation without the use of source routing. Finally, AOMDV computes alternate paths with minimal additional overhead over AODV; it does this by exploiting already available alternate path routing information as much as possible.This paper proposes AOMDV base load balancing and rate base congestion control in MANETs. The motivation is to reduce the packet loss in MANETs, typically which involves congestion control technique run-

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ning on top of a routing protocol at the transport and network layer. If congestion happens at the time of routing, it is detected and handled by congestion control.
The rest of this paper is organized as follows. In section 2 we discuss AOMDV routing protocol and the Section 3 has presents the related work and Section 4 has problem statement and in section 5 we discuss proposed scheme after that in section 6 we discuss about the network simulator-2. The section 7 has reprents the simulation results and finally in Section 8 presents the conclusion with future work.

3 Related Work

Here we are presenting survey about existing work done in the field of MANET routing protocol, congestion control under MANET.
This paper [5] 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. Thus, the packets transmitted by the source node are not increased.

In this paper [6] proposed a congestion controlled adaptive multi-path routing protocol to achieve load balancing and avoid congestion in MANETs. The algorithm for finding multi-path routes computes fail-safe multiple paths, which provide all the intermediate nodes on the primary path with multiple routes to destination. The fail-safe multiple paths include the nodes with least load and more battery power and residual energy. When the average load of a node along the route increases beyond a threshold, it distributes the traffic over disjoint multi-path routes to reduce the traffic load on a congested link.

In this paper [7] suggested that each node avoid the congestion in greedy fashion. This algorithm uses the alternative route towards the destination to avoid new routes forming through congested node. Each node finds the current status of interface queue size, where node considers 60 as maximum queue size. Queue size 50 is considered as congestion threshold. When a node notices that the congestion threshold has been reached, it automatically starts ignoring new RREQ packets so as to not allow any new routes passing through it.

In this [8] have proposed a new distributed load based routing algorithm intended for a variety of traffic classes to establish the best routing paths. This approach calculates the cost metric based on the link loads. Here multimedia traffic is considered as high priority traffic and its routing is carried out over the lightly loaded links such that the links at the lighter loads are selected as an alternative to links holding heavier loads. Also the resources are shared among the high and low (normal traffic) priority traffic. The lightly loaded path is used by normal traffic in the lack of multimedia traffic.

In this [9] have proposed a novel adaptive load balancing routing algorithm in ad hoc networks based on a gossiping mechanism. This algorithm merges gossip based routing and load balancing scheme efficiently. It adjusts the forwarding probability of the routing messages adaptively as per the load status and distribution of the nodes in the phase of route discovery.

In this [10] Their objective is to do use the ant based algorithm for load balancing by calculating threshold value of each routing table through average number of requests accepted by each node. According to this threshold value, they can control the number of ants that has been send. If the threshold value is less, it means the average number of requests to that particular node is low. Then they simply broadcast the ants for updating their pheromone table. If the average number of requests is high, then a data packet will be send according to the pheromone table of that particular node. Their work presents a new dynamic and adaptive routing algorithm for MANETs inspired by the ant colony paradigm.

In this [11] they develop ecMTCP. ecMTCP moves traffic from the most congested paths to the more lightly loaded paths, as well as from higher energy cost paths to the lower ones, thus achieving load-balancing and energy-savings. This paper 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.

In this paper [12] they propose a novel congestion control algorithm, named TCP-FIT, which could perform gracefully in both wireless and high BDP networks. The algorithm was inspired by parallel TCP, but with the important distinctions that only one TCP connection with one congestion window is established for each TCP session, and that no modifications to other layers (e.g. the application layer) of the end-to-end system need to be made. This work done only transport layer congestion control via TCP improvement method but congestion also occurs in routing time so that work enhance through routing base congestion control technique.

This paper [13] presents a new approach based on multipath routing backbones for enhanced load balancing in MANETs. Nodes in MANETs greatly differ with each other in terms of communication and processing capabilities. In the proposed approach, 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.

In this [14] proposed a "cluster based congestion control (CBCC) protocol that consists of scalable and distributed cluster-based mechanisms for supporting congestion control in ad hoc networks". The clusters autonomously and proactively monitor congestion within its localized scope. The present approach improves the responsiveness of the system when compared to end-to-end techniques. After estimating the traffic rate along a path, the sending rate of the source nodes is adjusted accordingly. Thus this protocol look forward the injection of dynamic flows in the network and proactively adjusts the rate while waiting for congestion feedback.

In this [15] proposed "QoS architecture for Bandwidth Management and Rate Control in MANET". The proposed

QoS architecture contains an adaptive bandwidth management technique which measures the available bandwidth at each node in real-time and it is then propagated on demand by the QoS routing protocol. The source nodes perform call admission control for different priority of flows based on the bandwidth information provided by the QoS routing. A rate control mechanism is used to regulate best-effort traffic, whenever network congestion is detected.

In this paper [16] the protocol preserved the multiple paths carrying a higher hop count value and used them as alternate routes in case of link failure. The major problem of node failure is congestion. 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. If Queue length crosses a certain threshold value then Load balancing via alternate paths is carried out.The protocol will avoid congestion on routes by carrying a good route discovery technique, balance load on account of congestion that would definitely to an extent avoid node failures and has improved packet delivery ratio, throughput, reduced packet delay and packet drop.

In this [17] proposed "an explicit rate-based flow control scheme (called EXACT) for the MANET network". In EXACT, flow's allowed rate is explicitly conveyed from intermediate routers to the end-hosts in each data packet's special control header. As a result, EXACT reacts quickly and precisely to rerouting and bandwidth variation, which makes it especially suitable for a dynamic MANET network.

4 Problem Statement

In this section, we have tried to point out the problems and performance degradation by using congestion control mechanism in mobile ad hoc networks. Congestion control is the most controversial parts of network, which degrades performance when encounters non-congestion loss in MANET. Congestion control assumes all loss induced by congestion. Congestion causes packet losses and bandwidth degradation and hence can waste time and resources.

5. Proposed Solution

In this approach we design AOMDV base load balancing and rate base congestion control in MANET environment that provide reliable as well as efficient communication. In this approach we are using AOMDV routing protocol to implement multipath routing in the network. AOMDV routing protocol establish multiple disjoint paths between sender and receiver after a route discovery process. The sender uses these multiple paths for sending data to receiver thus tends to balance the load of the network. Now whenever a sender wants to send data it uses multiple paths and every time it measures end-to-end delay as well as normal time (without congestion) acknowledgment delay difference and store it. Now we create the second scenario in which a number of TCP senders and receivers share common mobile node resulting congestion in the network which is unavoidable so each sender compares new acknowledgment delay difference with previous acknowledgment delay difference. If sender finds that delay are increasing from previous recorded time so it changes the data rate (minimum from previous). This bandwidth estimation technique through acknowledgment delay difference is applied to each TCP sender node and according to it each sender node changes its basic data sending rate and minimizes congestion in the network.

Second approach for congestion control is dynamic queue management technique in this technique dynamic queue is implemented at each node of a network so that congestion due to queue overflow will be minimized.

Both technique base we minimize congestion and increase the percentage of receiving data in the network as well as decrease average end-to-end delay of the network.

5.1 Proposed Algorithm

Create mobile node = M;
Set routing protocol = AOMDV;
Set sender = S;
Set Destination = D;
Initialise radio range = 550m;
Set MAC = 802.11;

Steps for Congestion Aware and control

Step1: Sender S sends data packet through shortest path to destination D;

Step2: Find out total incoming and outgoing data from each node; **// value from trace file**

Step3: Get drop data packet from each node;
Step4: Get reason of drop from trace file;
Step5: If (drop-reason == "COL" || "Congestion")
{
Set queue at that node;
If (Q > Max-val) **// if queue overflow**
{
Calculate in coming data rate and outgoing data rate;
If (rate > available) **// rate of incoming packet and available capacity**
{
Apply TCP acknowledge base approach for controlling data rate;
}
}
}

// sender side
Step1: Sender (rx-ack, time, seq-no)
{
Store ack1, ack2……ack_{n-1} ack_n ; **// store in the trace file;**
Capture time of ack receives;
Store seq-no for ack; **// calculate delay difference of ack**
Old-d = ack_2-ack_1; **//Old-d means initial delay difference**
New-d = ack_n – ack_{n-1};

```
// Compare delay
   Step2: If (New-d > Old-d)
       {
            Sender set new rate;      // on the bases of de-
lay
                                      difference
        }
       Else
         {
sender sends data actual rate ;
}
```

6 Simulation Environment

Table 1 are represents the following simulation parameters to make the scenario of routing protocols. The detailed simulation model is based on network simulator-2 (ver-2.31) [18], 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 receivers etc. are mentioned in table 1.

6.1 Expected Outcomes

TABLE 1
SIMULATION PARAMETERS USED FOR SIMULATION

Simulator Used	NS-2.31
Number of nodes	50
Dimension of simulated area	800m×600m
Routing Protocol	AOMDV
Simulation time	100 sec.
Traffic type (TCP & UDP)	FTP & CBR
Packet size	1000 bytes
Number of traffic connections	15
Node movement at maximum Speed	random & 20 m/s
Transmission range	250m

There are following different performance metrics have showed the expected results on the basis of following:

- ***Routing overhead*:** This metric describes number of routing packets transmitted for route discovery and route maintenance need to be sent so as to propagate the data packets. Routing overhead will be minimized due to AOMDV protocol.
- ***Packet Delivery Ratio*:** The ratio between the amount of incoming data packets and actually received data packets. It will also be maximized.
- ***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. It is expected to be good as compared to previous technique.
- ***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. It is expected to minimize because we are trying to reduce congestion in the network.

7 Simulation Results

This secrtion represents the simulation results that have evaluate on the basis simulation parametes and measure performance on the basis of performance metrics.

7.1 Routing Overhead Analysis

This graph represents the routing load analysis in case of old and proposed scheme. The routing overhead is measures on the basis of number of routing packets are delivering in network by sender for connection establishment with receiver. The more routing overhead means the sender are not sending the data in network it was taken the time for connection establishment in network by that the performance of network are degrades. Now in this graph the routing overhead in case of proposed scheme is less than the old scheme. In case of proposed scheme about 6500 routing packets are delivering in network but in case of old scheme about same routing packets are delivering in network but the difference is shown in overall analysis table 2. Proposed multipath protocol is not reduces routing overhead but if we add the concept of queue length then multipath protocol has also gives the better performance than normal multipath routing.

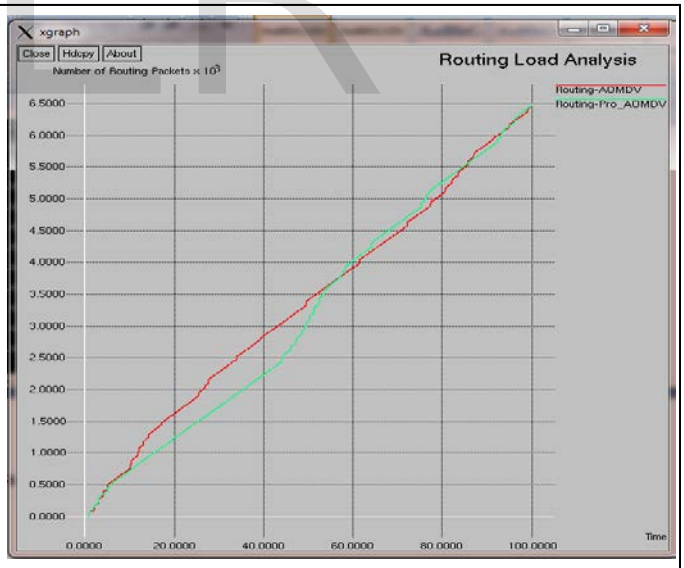

Fig. 1 Routing Packets Analysis

7.2 Packet Delivery Ratio (PDR) Analysis

Packet Delivery Ratio (PDR) is one of the important performance parameter to measure the performance of network but it is calculated on the basis of number of packets are received in network by number of packets sends in network. In this graph the performance of proposed and old scheme not very differs in tern of PDF. It means that

the PDF performance of proposed scheme is about 95% and previous scheme PDF is about 90%, the difference in performance is of 5%. The time in between 15 second to 20 second the performance of PDF is almost equal then one question is arises why the throughput is high in case of proposed scheme. It means in case of proposed scheme more number of packets are sending in network as compare to previous scheme or old scheme. Now the performances in term of PDF are only depend on the factor of packet receiving with respect to sender and how many actual number of packets are deliver in network are mentioned in **table 2 of overall summery.**

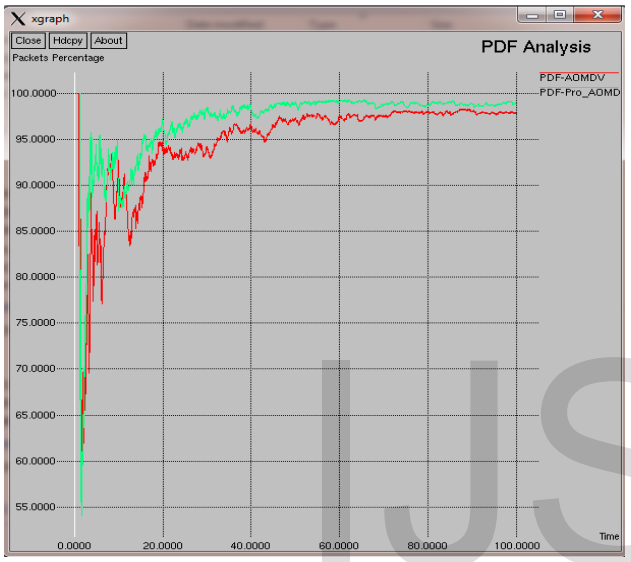

Fig. 2 PDR Analysis

7.3 Throughput Analysis

This graph represents the throughput analysis in case of normal AOMDV based routing and proposed queue length and rate control based AOMDV based routing. The throughput has represents the number of packets sends in per unit of time in network. Now if measure the performance of both the protocol then the performance of proposed protocol is better than normal multipath routing. Here we observe that in case of normal AOMDV based routing only nearby 1000 packets maximum are deliver in network in per unit of time but in propose scheme maximum more then 1200 packets are sends in network in per unit of time. It means that only the multipath protocol is not able to improve network performance the new technique if included with multipath protocol then the performance of network improves with congestion handling and load balancing

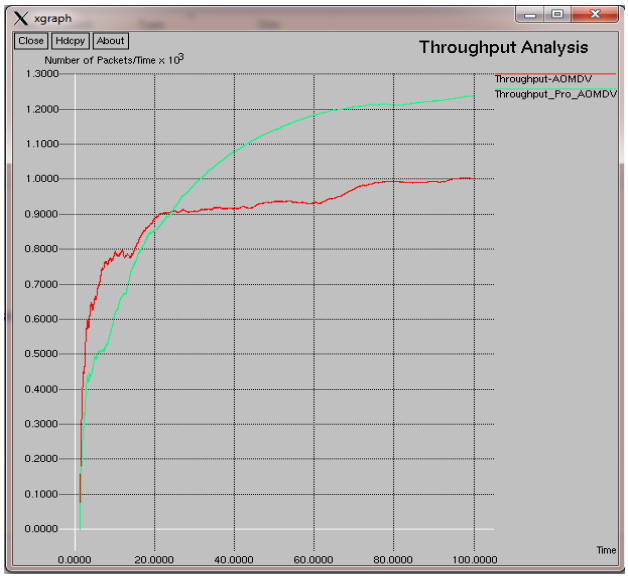

Fig. 3 Throughput Analysis

8 Conclusion and Future Work

The proposed AOMDV with queue length estimation technique has reduce congestion by choosing non congested routes to send RREQ and data packets and to transfer the load to higher hop count alternate paths if the nodes or route turn out to be congested. In other words, among paths that exist in the network, those paths that have longer lifetime and nodes along them have smaller queue lengths are selected for routing data packets along them. We present a AOMDV routing protocol for identification of possibly multiple node-disjoint paths between a given source and a destination such that the paths identified satisfy performance constraints. The performance of the network like packet delivery ratio, throughput and minimize the end-to-end delay of the network.

In future we apply proposed scheme with any location aware protocol like DREAM or LAR and analyses the effect of location aware protocol on energy consumption and also apply the energy efficient routing scheme in WIMAX technology to find the proper energy consumption on it.

TABLE 2
Overall Summery of Performance

Performance Parameters	AOMDV	Proposed AOMDV
Packets Send	6072	7156
Packets Received	5938	7065
Routing Packets	6280	5550
NRL	1.06	0.79
PDF	97.79	98.73
End to End delay(ms)	261.23	266.48
Data Drop in Packets	130	86
Data Drop in bytes	134120	89440

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