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Flow Count Based Congestion Control Mechanism in Mobile Ad Hoc Network

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Abstract: **MANET is a communication medium in daily human life and applications areas of MANET are growing rapidly. Congestion control and security are major tasks in MANET. Congestion occurs when the source sends more packets than the destination can handle Congestion control works very well in TCP over internet. But due to dynamic topology congestion control is a challenging task in mobile ad hoc network. Many approaches have been proposed for congestion control in MANET. In this paper, we propose the solution for the problem of large rate of packet drop and long and unfair end-to-end delays occurring in large networks while using the existing flow count mechanism for congestion control. We make use of a queue status signal to the sender, to change its sending rate accordingly. Network behavior has been simulated using NS2.32,with AODV as routing protocol and performance has been measured on parameters such as number of dropped packets, packet delivery ratio and end-to-end delay. The outcome is then compared with proactive protocol (DSDV).**

Keywords: **Mobile Ad-hoc Network (MANET), Dynamic Source Routing (DSR), Ad hoc On-Demand Distance Vector (AODV), Destination Sequence Distance Vector (DSDV).**

I. INTRODUCTION

I. MANET:

Ad hoc means arranged, or happening whenever necessary, and not planned in advance. Mobile ad hoc network is a collection of independent nodes which forms a temporary network without any fixed infrastructure or central controller. Each device in a MANET is free to move independently in any direction. The movement of nodes is random, thus providing a dynamic topology. There are lots of issues and challenges in designing a MANET network. One of which is Congestion.

II. Congestion In MANETS:

Congestion in a network may occur if the load on the network (the number of packets sent to the network) is greater than the capacity of the network (the number of packets a network can handle). Congestion happens in any system that involves waiting. It occurs because routers and switches have queues- buffers that hold the packets before and after processing. It degrades quality of service and also can lead to delays and loss of data. Congestion can be brought on by several factors. If all of a sudden, streams of packets begin arriving on three or four input lines and all need the same output line, a queue will build up. If there is insufficient memory to hold all of them, packet will be lost. This problem cannot be solved by increasing memory, because Nagle discovered that if routers have an infinite memory, congestion gets worse, not better. Slow processor can also cause congestion. If routers' CPUs are slow at performing the bookkeeping tasks required, queues can build up, even though there is excess line capacity. Similarly, low bandwidth lines can also cause congestion. Congestion leads to packet losses and bandwidth degradation and waste time and energy on congestion recovery .In Internet when congestion occurs it is normally concentrated on a single router, whereas, due to the shared medium of the MANET congestion will not only overload the mobile nodes but has an effect on the entire coverage area.

III. Congestion Control Mechanism:

Congestion control refers to the mechanism and techniques to control the congestion and keep the load below the capacity. It is a mechanism that can either prevent congestion, before it happens, or remove congestion, after it has happened. There are many mechanisms developed for congestion control, one such is End-system flow control. This is not a fully fledged congestion control mechanism scheme, but it prevents the sender in network from overflow the receiver's buffer, in a way preventing congestion.

IV. Flow Control:

Flow control limits the amount of data transmitted by the sending transport entity to a level, or rate that the receiver can manage. At the transport level flow control will allow the transport protocol entity in a host to restrict the flow of data over a logical connection to the transport protocol entity in another host. TCP uses an end-to-end flow control protocol to avoid having the sender send data too fast for the TCP receiver to receive and process it reliably. Having a mechanism for flow control is essential in an environment where machines of diverse network speeds communicate.

II. RELATED STUDY

Prerna et al,[1] presented an Effective Flow Count Mechanism for Congestion Control in MANET. The algorithm provides congestion feedback by varying the number of packets per sender in proportion to the queue length. This approach has the enviable cause of reduced queuing delay, fewer packet drop however it produces high loss rate as the number of flows increases, causing long and unfair timeout delays in case of large networks.

S. Subburam et al, [5] presented predictive congestion control routing protocol for wireless Ad-hoc networks called as PCCAODV. In ad hoc networks connection failure between source and destination often occurs, because of transition of nodes. The connection between source and destination gets disconnected after every failure. The problem is while sending data packets from source to destination, there is a probability of congestion occurrence at any node resulting in long delay and high packet loss, which leads to performance dilapidation of a network. Unlike traditional AODV, predictive congestion index of a node as the ratio of current queue occupancy over total queue size at node level. PCCAODV utilizes the upstream nodes and downstream nodes of a congested node based on a congestion index and initiates route finding process Bi-directionally to find alternate non congested path between for transmitting data. The protocol is implemented and simulation is done using Ns-2 simulator.

G.Vijaya Lakshmi et al, [6] suggested a queuing model to overcome the congestion problem in mobile adhoc network. The queuing mechanism is developed based on the probability distribution in different range of communication. The queuing mechanism hence improves the network metrics such as overall network throughput, reduces the route delay, overhead and traffic blockage probability. The approach is generated over a routing scheme in adhoc network.

Sanjeev Patel *et al.* [8] had shown a comparative analysis of throughput, queue length and delay for the various congestion control algorithms REM, SFQ and RED. He also included the comparative examination of loss rate for these algorithms having diverse bandwidth. Stochastic Fair Queuing (SFQ) guarantees fair access to network resources and prevents a busty flow from consuming more than its fair share. In case of (Random Exponential Marking) REM, the main implication is to decouple congestion measure from performance measure (queue length, delay or loss). Stabilized RED (SRED) is an additional technique of detecting nonresponsive flows.

Dr. Yogesh Chaba1 et al, [2] define congestion as the loss of utility to a network user due to high traffic loads and congestion control mechanisms as those that maximize a user's utility at high traffic loads .He consider the problem of protecting well-behaved users from congestion caused by ill-behaved users by allocating all users a fair share of the network bandwidth. Fairness is said to be done when equal numbers of packets are received from each node and this will be achieved by limiting the queue size and limited bandwidth .This aggregate queue orders packets based on their timestamps rather than arrival order. Through simulation, we show the performance of reactive protocols like AODV, DSR and AOMDV.

Wu-chang Feng, *et al.* [9] proposed, put into practice, and evaluated an active queue management algorithm, termed as BLUE. Using experiments done through simulation, it is analysed that BLUE performed notably better than RED, both in terms of buffer size requirements and packet loss rates in the network. He also proposed and examined another queue management algorithm, Stochastic Fair BLUE (SFB), which can recognize and rate-limit nonresponsive flows using a infinitesimal amount of state information.

Yuming Jiang *et al.* [7] proposed S-SFQ which is a single queue design and implementation of the well-known Start-time Fair Queuing (SFQ). This aggregate queue orders packets based on their timestamps rather than order of arrivals. With the help of simulation, we show the performance gains of S-SFQ over other default single-queue schemes such as RED and FIFO in terms of link utilization and flow fairness.

Dr.Ramachandra.V.Pujeri, et al, [3] put forward to develop the Effective Congestion Avoidance Scheme (ECAS), which consists of congestion less based routing, effective routing establishment and congestion monitoring. The overall congestion status is calculated in congestion monitoring. As far as routing establishment is concerned, he proposed the contention metric in the particular channel by considering packet queue length, packet loss rate and drop ratio of packet to monitor the congestion.

Dan Rubenstein *et al.* [4] proposed techniques based on delay or loss observations at end hosts to examine whether two flows experiencing congestion are congested because of the similar network resources. His new result is that this research holds good for unicast flows and the same procedures can also be applied in the case of multicast flows. He also put forward metrics which can be used for measuring the amount of congestion sharing between two flows.

Ehssan Sakhaee *et al.* [10] present a scheme for reducing overall traffic and end-to-end delay in highly MANET networks. In this a new routing algorithm is introduced to reduce the frequency of flood requests by increasing the link duration of the selected paths. In order to lengthen the extent of path, non unlink paths are taken into consideration. This concept is a new approach in route discovery as previous reactive routing protocols seek only disjoint paths. The basic concept behind this scheme is to broadcast only specific and well-defined packets, referred to as “best packets” in the paper. The new protocol is simulated with respect to traffic overhead. Although his main aim in this paper is to reduce the net control traffic in a MANET network, there are other advantages arising from the proposed schemes, namely the increase in duration of link, reduction in the end-to-end delay, less disturbance in flow of data, and less path setups.

III. PROPOSED WORK

In this paper, we propose a flow control mechanism for congestion control in MANET. We have used simulation (NS2 2.32) on network parameters such as Packet Delivery Ratio, Number of dropped packets and end-to-end delay. The main work done in this paper is :-

1. To study the performance of existing flow control mechanism.
2. To develop an enhanced flow count mechanism on Reactive Protocol AODV.
3. Compare the existing algorithm with our proposed work.

In the existing technique, authors have given a flow control based mechanism to handle the congestion but flow control affects the performance largely as the packets are delayed from flowing over the large network. Also authors have stated in their result that, as the number of nodes increases, the rate of data packet loss and end-to-end delay increases.

We propose to maintain a count of incoming and outgoing packets both on a node, at a particular time. This gives the idea of actual traffic over the link between the two nodes. If the link is over burdened then sender can be informed by the receiver to slow down from putting more packets on the link to it. If the sender receives this message then it can decide to send more packets on other links available to it.

Our proposed work follows the given steps:-

Step 1:

Modify the packet of RREP to accommodate the information to be enclosed by the receiver. This will be simply done by adding one bit extra on the RREP (0 for normal, 1 for slow down)

```
struct hdr_aodv_rrep_ack {
        u_int8_t rpack_type;
        u_int8_t reserved;
        u_int8_t lnk_status; };
```

Step 2:

Putting the condition that if the number of packet is greater than 50 the link status should be 1 else it should be 0.

```
if(packetCount>=50) {
        rp->lnk_status=1;
 }
 else {
        rp->lnk_status=0;
 }
```

Step 3:

Modify the aodv_packet to forward the packet to other nodes if the lnk_status is set to 1 from one of the next node (RREP sender) as follows:

Since we are implementing AODV using 802_11 protocol hence on each node we will receive RREP on the following function

```
Void Mac802_11::recvCTS(Packet *p)
{
        if(tx_state_ != MAC_RTS) {
                discard(p, DROP_MAC_INVALID_STATE);
                return;
        }
        assert(pktRTS_);
        if(p->lnk_status == 0) {
                Packet::free(pktRTS_); pktRTS_ = 0;
        }
        assert(pktTx_);
        mhSend_.stop();
        * The successful reception of this CTS packet implies that our RTS was successful.
        }
```

IV. TOOLS USED

NS-2.32 simulator is used for performance evaluation. The network is a collection of 10-100 nodes deployed on square area of 1200m x 1200m. Transmission range of each node is 250 m. The medium access control (MAC) protocol based on IEEE 802.11 with 2 Mbps raw capacity. In radio propagation model, a two-ray ground reflection model is applied. In all simulations, we will use the RWP (Random waypoint) mobility model.

Table.1 Simulation Parameters

Simulator	NS-2.32
Total number of nodes	20-100
Simulation Time	15
Simulation Area	1200m x 1200m
Propogation Model	Two-Ray ground reflection model
Mobility Model	RWP(Random waypoint)
Radio Range	250 m
Mac Protocol	IEEE 802.11
Data Packet Size	512 Bytes
Antenna	Omni Directional
IFQ Length	50
Routing Protocol	AODV , DSDV
No. Of Packets Per Second	5
Traffic	CBR

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V. RESULTS AND DISCUSSION

Performance of existing flow control mechanism and our proposed flow count mechanism was compared using AODV reactive protocol. Further the improved AODV protocol is compared with proactive protocol DSDV. For investigating the performance of our proposed mechanism, the following performance metrics were taken into consideration:

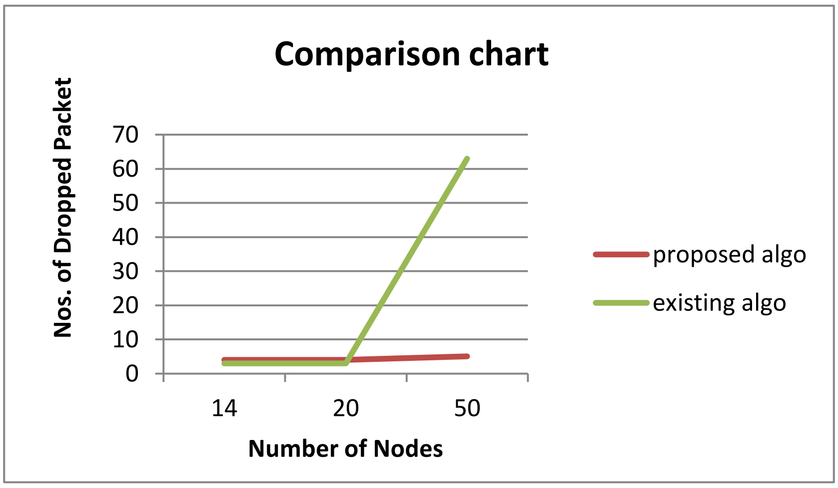
Number of Dropped Packets : Drop packets are those packets which are dropped during the simulation. Dropped packets are generated during simulation but not received by the receiver.

Packet Delivery Ratio (PDR): It represents the ratio between the packets generated by the sources and the packets arriving at the destination.

Average End-to-End delay: It refers to the delay acknowledged by the successfully delivered packets in arriving to their destinations. This is an appreciable metric to compare protocols. This signifies how capable the particular routing algorithm is, because delay mainly depends on the path chosen.

Table.2 Nos.of Dropped Packet w r t Number of nodes in Existing Algo and our Proposed work

Number of nodes	Existing Algorithm	Proposed Algorithm
14	3	4
20	3	4
50	63	5

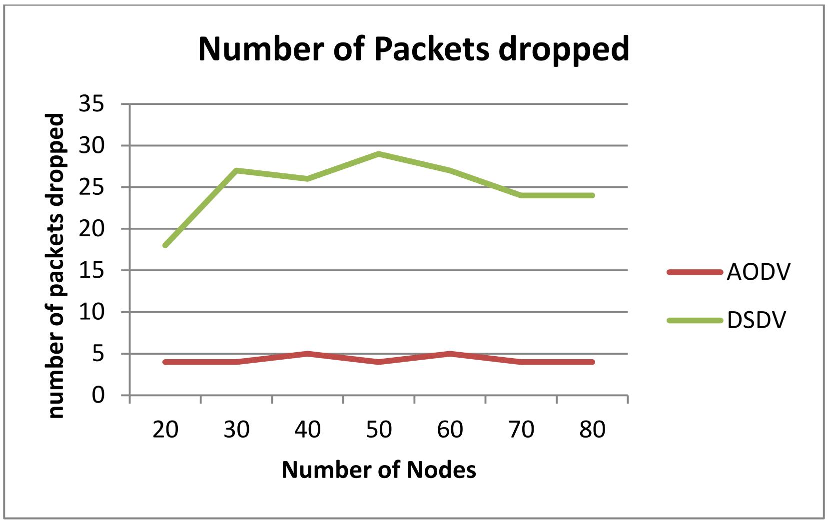


Graph 1.Comparison between existing Algo and our Proposed algo w.r.t. Nos of dropped packet

In the above graph, X-axis represents number of nodes and Y-axis represents the number of packets dropped. The green line represent existing algorithm and red line represents proposed algorithm. Thus, it shows the proposed algorithm is better than the existing one, as the number of packets dropped has decreased.

Table.3 Number of Packets dropped

Number of nodes	AODV	DSDV
20	4	18
30	4	27
40	5	26
50	4	29
60	5	27
70	4	24
80	4	24

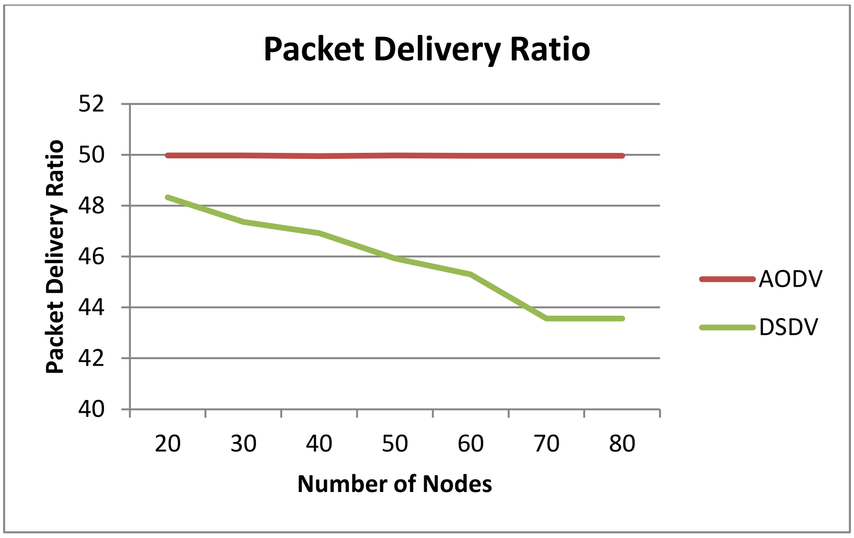


Graph.2 Nos. of packets dropped Vs Nos. of Nodes

From Table.3 And its corresponding graph (Graph 2),we can conclude that the numbers of packet dropped is more in DSDV as compared to our improved AODV protocol.

Table.4 Packet Delivery Ratio.

Number of Nodes	AODV	DSDV
20	49.97	48.33
30	49.97	47.36
40	49.95	46.92
50	49.97	45.93
60	49.96	45.30
70	49.96	43.57
80	49.96	43.57

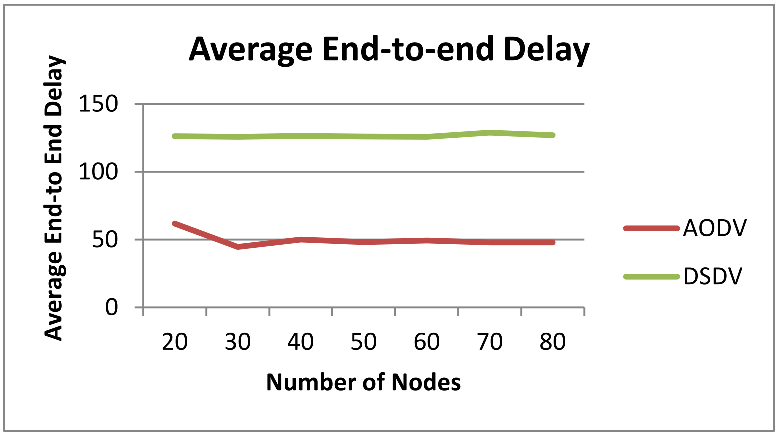


Graph.3 Packet Delivery Ratio

From table 4 and corresponding graph (graph.3) we deduce that Packet delivery ratio of AODV is more as compared to DSDV.

Table.5 End-to-End Delay

Number of Nodes	AODV	DSDV
20	61.64	126.06
30	44.61	125.73
40	49.92	126.29
50	48.11	126.02
60	49.17	125.76
70	47.82	128.85
80	47.82	126.86



Graph.4 End-to End Delay

From table 5 and corresponding graph (graph 4) we can conclude that Average end-to-end delay in AODV is less than that in DSDV.

The result of this simulation shows that our proposed flow count mechanism works better in MANET irrespective to the number of nodes present .Through this work we have removed the high packet lost and long time delay problem existing in the previous work.

VI. CONCLUSION

In this paper, AODV reactive protocol is studied, we tried to improve the performance of existing flow count mechanism, using AODV protocol. The performance evaluation parameters are Packet Delivery Ratio, Number of packets dropped, and Average end-to-end delay. We have surveyed the impact of varying number of nodes and Flow Count on network performance. We have compared the improved flow count based AODV protocol with DSDV. In this paper we address the problems with existing congestion control algorithms and we tried to show packet drop does not depend on the size of the network. In this thesis a simple flow counting mechanism is presented. The algorithm provides congestion control mechanism by making use of a queue status, which actually informs the sender whether it is ready or not to receive the data packet. This approach has the enviable cause of improved packet delivery ratio, fewer packet drops, and lesser end-to-end delay in large network. The AODV protocol being used provides superior results (as compared to DSDV) as it allows the network to completely self configuring and self organizing devoid of necessitate of existing network.

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