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Congestion Control Mechanism for Multicast routing in MANETs

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Abstract— **Mobile ad-hoc networks (MANETs) consists of numbers of mobile nodes which is connected wirelessly without any fixed host or router. Hence the nodes are moving in random fashion, efficient routing protocols is very essential to route the packet data to destination point .Multicast routing guarantees successful data delivery between the nodes .In the case of mobile nodes, to allocate the network resources among the number of users is a major issue. This paper presents, congestion control in multicast routing protocols like MAODV(Multicast ad- hoc on demand distance vector).Solution is introducing TCP VEGAS congestion control mechanism .Simulation results shows performance of MAODV protocol before and after avoidance of congestion in routing.**

Index Terms— **Multicast routing, MAODV, TCP VEGAS.**

I. INTRODUCTION

Mobile ad hoc networks (MANETs) [1] are temperarory networks that applicable in different environments like flood, earthquake, disaster situations .Since all nodes move randomly and communication between them done through multi hop wireless links. If two mobile nodes are in same range the communication between these nodes can be made through one or more adjacent nodes. Multicast routing is an efficient way of transmitting number of packets from one point to multiple points, thereby reducing network bandwidth. Finally multicasting plays an important role for communication in MANETs in an area of group communication is deployed.

MAODV is a tree-based multicast routing protocols in which all the nodes in the network form a tree branches with the source node as the root and others as the intermediate tree nodes [3],[4] .To assign network resources effectively and good among a collection of users is a major issue. Since the resources is bandwidth limited to the links and the queues on the routers or switches. Packets get queued in the respective link. When too many packets are routing for the same link or route, the buffer overflows and packets gets dropped which leads the network is said to be congested. So enhancing the MAODV protocol with a congestion control mechanism to slow the data rate of the sender when the network is congested. Vegas is an implementation of TCP that achieves 70% better throughput and reduce about 40% losses, as compared to the network which is congested.

Three important phases are commonly in TCP VEGAS [2] congestion control mechanism .They are slow-start congestion avoidance, Fast Retransmission phase. The main function of Congestion Window (CWND) measures the capacity of data which is limited to transmit at the available bandwidth. Once the acknowledgement is received back with in time out then CWND is doubled then starts the slow start. When it reaches the slow-start threshold (thresh) grows by increasing the data size to the CWND every ACK received .This stage continues as until packet loss causes. Then start congestion avoidance mechanism that reduces the threshold value to half the current CWND .Hence TCP VEGAS detect congestion at the early stage which then increases the network performance.

In MANETs [7] as in Fig I**,** congestion causes due to limited resources and finally lead to high packet loss, long delay and resource reduce utilization time. But congestion control is to best limit the available network resources by keeping the flow of data below the required bandwidth. TCP gradually discover the network by determining the bandwidth and available capacity. This will prevent the network from being congested with large rush of data.

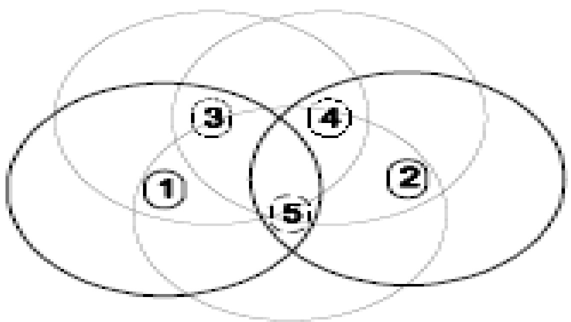

Fig I**:** Ad- hoc network with mobiles range

This paper presents the congestion detection and avoidance methods in multicast routing protocol like MAODV [8].TCP variants like VEGAS is implemented as the congestion control mechanisms. Hence TCP congestion control

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improves the throughput effectively and reduces packet drops and delays that increases the network performance.

II. TCP VEGAS

TCP (Transmission Control Protocol) [3] achieves unreliable data service supported by IP over the Internet. TCP reduces delays, deletes duplication, and decreases overloading and also successful data delivery. It also has major features like connection orientation, full duplex communication point-to-point communication, reliability. Hence TCP supports more number of mobile users to support file transactions over the systems.

III. Congestion Control Algorithms

Congestion is determined by delay and loss of packets at the destination point. In TCP, congestion occurs when the sender receives more than three duplicate acknowledgments or when a time period expires, resulting in wastage of network resources. In TCP VEGAS for every acknowledgments Retransmission Time Out (RTO) were set and round-trip delays is noted for every segment in the transmitted window [6], [7]. In addition TCP Vegas produces exponential growth in the congestion window.

Three phases of congestion control in TCP VEGAS:

a) Slow -Start.

The slow- start phase starts when a packet loss is detected during which takes place a large increase in bandwidth which leads to congestion in the processing link. Hence maintaining the congestion window in three phases is very essential thus saving the required bandwidth. To prevents congestion start up with slow-start phase. At beginning, it calculates the current rate to the expected value and their difference is above a certain threshold value it enters the congestion avoidance phase.

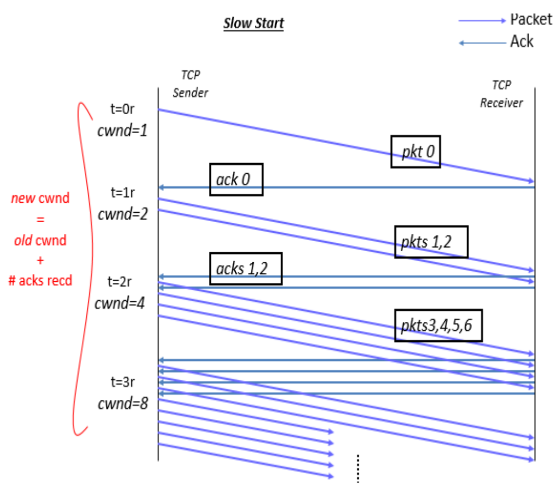

Fig II: Slow – Start phase.

Fig II is based on Algorithm 1

1: Calculates the Current and Estimated values (once per RTT)

Where, Current value= actual data value /RTT

Predicted value= CWND Size/Minimum RTT

2: Measure the difference (Current value- Estimated value) on every RTT based on the static variable, α = 1 packet/RTT and measures throughput,

3: If (Diff<α)

Then, CWND=CWND+1

4: Else (Diff>α)

Then, Switch to algorithm 2.

5: Finally, set thresh =CWND

6: Rules to Algorithm 2

b) Congestion Avoidance.

TCP Vegas detects congestion in the first phase and avoids congestion in the congestion avoidance phase. During this phase congestion window is reduced based on the current value, avoids large packet drops. Based on the RTT, congestion window is increased or decreased linearly with the previous window size. There by producing better throughput if there is sufficient capacity.

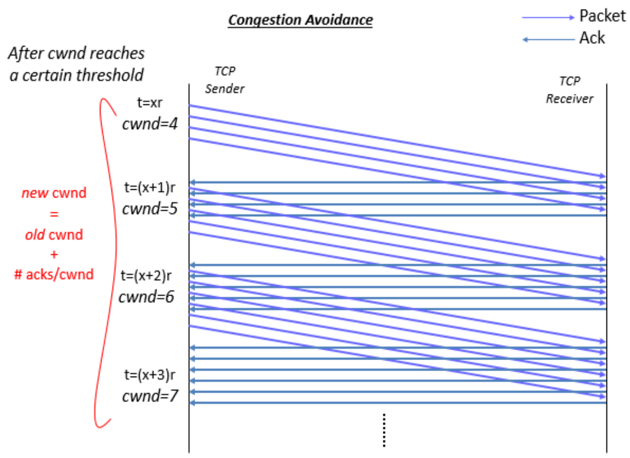

Fig III: Congestion Avoidance Phase.

Fig III is based on Algorithm 2

1: Calculates the Current and Estimated values (once per RTT)

Where, Current value= actual data value /RTT

Predicted value= CWND Size/Minimum RTT

2: Check the difference (Current value- Estimated value) Here CWND size updated by checking the difference with the variables (α, β)

3: If (Diff < α), then CWND = CWND- 1/CWND

4: If (Diff>β), then CWND = CWND +1/CWND

5: If (α<Diff<β), then CWND= current CWND.

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c) Fast Retransmission

TCP VEGAS undergoes some changes in this retransmission phase. Initially, TCP Vegas undergoes to estimate RTT for every data packet sent. By measuring different RTT values, a timeout period for each segment is observed. When a duplicate message (dup ACK) is received, TCP Vegas checks whether RTT has expired. If the time expires, then the data is retransmitted .Otherwise, when more than one duplicate message is received, then Vegas again checks for the timeout and transmit another packet. Finally, if multiple packet loss and more than one retransmission occurs, then the congestion window is decreased only for the first retransmission.

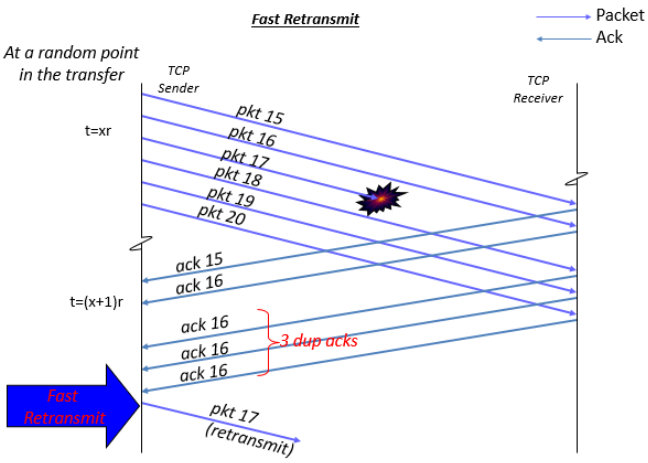

Fig IV: Retransmission phase

Fig IV explains the following.

1: With a non- duplicate ACKS,
When TCP receives more than one non -duplicate ACKS, it checks the current RTT.
2: If timeout expires, then retransmit the packet.
3: With a partial ACKS,
For first two ACKS, checks whether timeout expires,
4: If time expires, retransmits immediately.

TCP Vegas gives minimum packet loss for MANETs [2], [9], also increase the throughput in MAODV multicast routing protocol. In slow-start phase vary the congestion window, because congestion window will affect the performance of TCP Vegas. For congestion avoidance phase, change in congestion window will help to minimize the congestion and due to less congestion, packet loss occur minimum and it will also help in to increase throughput and reduce delay as well.

IV. PERFORMANCE RESULTS

Simulation is performed by using NS2 tool. This paper different comparison is evaluated with various network environments and compared with the MODV protocol with and without implementation of TCP VEGAS.

1)Throughput

The average rate at which the data packet is delivered successfully from source to destination over a communication channel. The fig below shows the throughput performance of the MAODV protocol with congestion and without by implementing VEGAS.

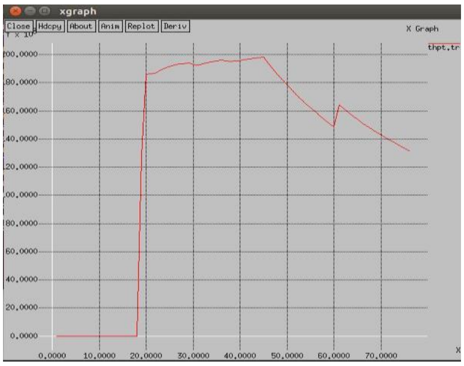

Fig V (a): MAODV with congestion

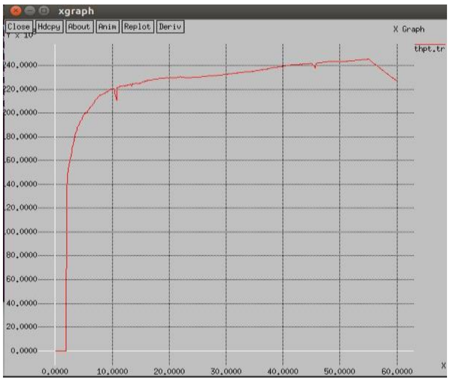

Fig V (b): MAODV with congestion avoidance

2)End to End Delay

End-to-end delay refers to average time period taken for a packet to be transmitted from source to destination within the network. It is an additive delay that includes transmit delay, propagation delay and processing delay in the network.

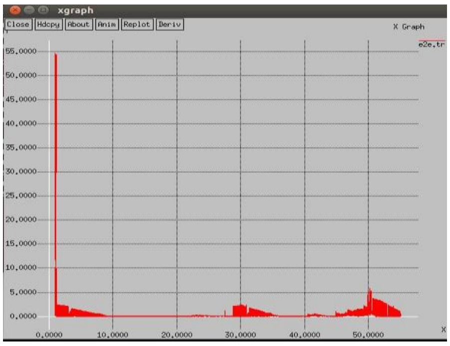

Fig VI (a): MAODV with more delay

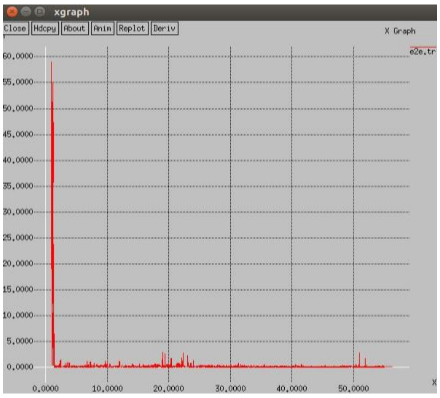

Fig VI (b): MAODV with less delay

V. CONCLUSION.

TCP VEGAS congestion control in MAODV multicast routing improves the average network performance by utilizing the packet loss after the first time out itself than any other mechanism. Hence the throughput provides about 70% better performance and reduces delay of 40% at the beginning.

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