International Journal of Trend in Scientific Research and Development (IJTSRD)
International Open Access Journal
ISSN No: 2456 - 6470 | www.ijtsrd.com | Volume - 2 | Issue – 5

Performance Analysis of Congestion Control Algorithm for Mobility Model in Mobile Ad-Hoc Networks (MANET)

Kirtiraj Mohan Desai[1], **Prof Ms. T. T. Mohite Patil**[2]
[1]M.E Student, [2]Professor
Sanjeevan Engineering & Technology Institute, Panhala, Kolhapur, Maharashtra, India

ABSTRACT
The mobile ad-hoc networks (MANET) is network where the mobile nodes move randomly and freely without any centralized administration or control. Where mobile nodes in MANET works both as routers and as hosts. As we know the challenges faced by the wireless and distributed nature of ad hoc networks such the chances of losing packets over the network increases to a great extent as well as the packet loss occurring with the increase in size of the data packets which are often responsible for congestion in the network. Now In order to detect congestion in the network, there are various congestion control algorithms are used. This paper gives a study of the congestion control algorithm used in MANET's and tries to propose a simple congestion control algorithm for mobility models such as random walk model for MANET's. The objective of this paper is to design an efficient congestion control technique to reduce the amount of congestion in the network.

KEYWORD: *MANET, Routing, Congestion and TCP.*

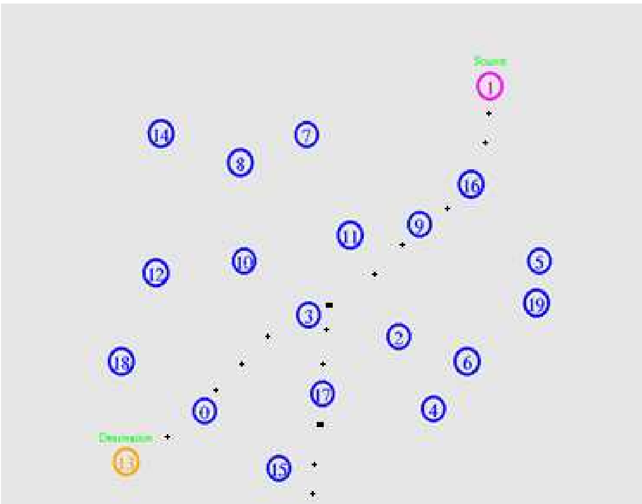
1. INTRODUCTION

The Mobile Ad-hoc network (MANET) is dynamically self-configuring network of wireless number of mobile nodes without having any centralized control to form an topology. The number of nodes present in MANET's are free to move randomly and rapidly from one location to the other without any control. The network's wireless topology is unpredictable and often changes rapidly [5]. The important characteristics which differentiate MANETs from other wireless networks is its mobility. There are many Applications of Ad-hoc network in various fields such as military communication and operations, emergency services like disaster recovery, commercial and day to communication services [3].

An ad hoc network can be defined as an arranged or happening whenever necessary and not planned in advanced works dynamically [1]. The nodes in MANET's moves freely in and around the network without any kind of restriction i.e. it has dynamic topology. MANET acts as a collection of mobile nodes where each node not only acts as a terminal or host but also acts as a router which does the work of forwarding the data from source to destination. Due to the independent behaviour of MANET's, there are also number of problems and challenges occurring in designing of MANET networks.

Although MANET's provide communication support where there are no any fixed infrastructure, because of the mobility and presence of limited resources various problems arises that require higher level research. The issues include security, topology control, quality of service (QoS), routing efficiency, power management, congestion control etc. [2]. The main problems which arise in wireless networks are network congestion and traffic blocking. Congestion problem occur in MANET's when the amount of load in the network exceeds the available resources which results in high overhead, packet loss and long delays. If congestion occurs in the network then data will not be transmitted more efficiently leading to high packet loss. To avoid the congestion in the network, we are required to use an efficient congestion control algorithm for successful transmission of data throughout the whole network.

The other of the section of the network is organized as follows. Section II shows a brief description about the congestion in MANET's and also in the congestion control algorithm. Section III gives a detailed description about the related work which is done by various researchers in this field. Section IV gives the simulation results performed in analysis and in section V we tried to propose the congestion control algorithm performed. And in the end section VI gives the references.



2. CONGESTION AND CONGESTION CONTROL ALGORITHM IN MANET'S

2.1 Congestion in MANET's

Congestion can be defined as barriers where successful communication does not take place. It is a situation in network communication where a lot number of packets are present in the subnet that can be handled [5]. One of the reason for congestion is that the presence of limited resources or when the offered load is much greater than the available capacity that can be handled by the channel. Congestion eventually leads to inefficient work by high packet loss and bandwidth degradation and waste energy and time in its recovery [6]. Congestion can create the following difficulties:

1. Long Delay: The congestion control mechanism takes a lot of time for detecting congestion. When the congestion is very high, it is preferred to find & select an alternate new path.
2. High overhead: The discovery of new routes for processing and communication. When the multipath routing is used, there requires additional effort for maintaining multipath irrespective of the existence of alternate route.
3. Many packet losses: The Congestion always leads to packet losses. In order to minimize the traffic load, a congestion control solution needs to be applied either by reducing the sender rate at the sender's side or by dropping the packets at the intermediate nodes or by applying both the methods.

2.2 Congestion Control in MANET's

The congestion occurs in MANETs because of the presence of partial resources and for the recovery a lot of energy and time is wasted doing so. Congestion control method is the technique by which the network bandwidth is distributed throughout multiple end-to-end connections [6]. Congestion control may be rate based or buffer based. Rate based congestion control scheme is commonly applied for routing. The basic idea for applying any congestion control technique is to increase the throughput ratio, to increase packet delivery ratio and node transfer in the network and to reduce end-to-end delay, traffic congestion in the network [7].

3. THE BACKGROUND STUDY

The Transmission Control Protocol or TCP is the internet protocol which carries the 90% of the internet traffic in both wired as well aswireless networks. TCP is mostly used all over as a connection-oriented transport layer protocol which provides efficient data transfer between different applications. The important services provided by TCP such as reliability, efficient data transfer, data flow control, multiplexing, congestion control and connection management [8]. However, TCP congestion control might not be suited well for MANET's where packet loss occur result in invocation of TCP's congestion control mechanisms. In this part we will illustrate about TCP variants for congestion control and then we will give an overview on the different congestion control mechanisms in MANET. The reason behind the variations of TCP is that each variant possess a special characteristic. The different variants are given below:

1. **TCP Tahoe:** Traditional TCP or TCP Tahoe was proposed by Van Jacobson was the first TCP variant for congestion control. It is based on the principle of 'conservation of packets' i.e. when the available bandwidth capacity in the network is running out, a packet will not be injected into the network unless a packet is taken out from the network. TCP Tahoe often starts through slow start process and by doing so congestion window is also maintained. For congestion avoidance it uses Additive Increase Multiplicative Decrease or AIMD technique. The main drawback for this variant is that it takes a complete timeout to detect

a packet loss which offers a cost in high bandwidth delay product links [8].

2. **TCP Reno:** Reno has the basic principle of Tahoe of slow start and cross grain but adds an extra feature that the lost packets are detected earlier and when a packet loss occurs the pipeline is not emptied every time. An algorithm called fast retransmit is applied which states that whenever 3 duplicate ACK's are received, it is taken as a sign that the segment was lost and the segment was again retransmitted over the network without waiting for timeout. But this algorithm does not work well for multiple packet losses.
3. **TCP New Reno:** New Reno is a modification of Reno in which it is able to detect many packet losses. The TCP Reno has a basic principle of such as slow start, congestion avoidance and fast re transmit. But it adds an extra feature called fast recovery which allows multiple retransmissions. The problem with this variant is it takes one RTT to detect each packet loss.
4. **TCP Sack:** TCP Sack or TCP Selective Acknowledgement is an extension of TCP Reno. TCP sack also has every the feature of the Reno and Tahoe such as slow start, coarse grained transmission, fast transmit and fast recovery. It works on the problems faced by TCP New Reno namely detection and retransmission of lost packets in one RTT. TCP Sack requires such segments which are have not been acknowledged cumulatively but to be acknowledged selectively. A new packet is sent if there is no outstanding segment. But the main disadvantage is in the implementation of selective acknowledgement, it is not an easy task.

There are different proposed congestion control algorithms for MANET's which are discussed as following:

The technique for MANET's called agent based congestion control for AODV protocol is proposed. In this method the mobile agents MA collects and distributes the information about network congestion. This technique is proposed to avoid the congestion in ad-hoc networks. The main function of the MA is that it starts form a node and moves to its adjacent node from time to time and updates the routing table of the node during its visitation. The node receives the dynamic network topology with the support of the mobile agents. This technique reduces end-to-end delay and tries to attain a high throughput and packet delivery ratio.

Congestion Adaptive AODV routing protocol CA-AODV is proposed whenever multimedia based traffic such as voice, audio, video or text is transmitted over the network. CA-AODV is implemented so as to address the congestion issues considering routing overhead, delay and packet loss. This protocol ensures the availability of alternative routes along with the primary routes to reduce the routing overhead. Whenever while performing, congestion is occurred in the primary route between source node and destination node, then the concerned node does the work of warning its previous node about congestion occurred and an alternate route is selected for transmission to the destination node. This algorithm is concerned for real time communications and is useful for better performance in heavy traffic as well.

In [10], the TCP variants like TCP Reno, TCP New Reno, TCP Sack, TCP Vegas have been analysed, implemented and compared for three different types of routing protocols. The routing protocols taken in consideration are AODV, DSDV and DSR. The various performance metrics like throughput, packet delivery fraction and end-to-end delay are calculated and by doing so we came to know that TCP Vegas is better than any other TCP variant.

Due to the constant movement of nodes in MANET's, energy consumption is higher due to the retransmission of the packets and packet loss. The main objective in this paper is to ensure energy efficiency in the network. In [11] an energy efficient based congestion control scheme (EECCS) is proposed to improve energy consumption and energy efficiency of the mobile nodes. By the simulation results it is found that the proposed scheme achieves minimum energy, low packet loss, low end to end delay, high packet delivery ratio and throughput.

An agent based congestion control technique is proposed where the information about the network congestion is collected and distributed by the mobile agents. This algorithm was proposed to avoid congestion in the network. The routing protocol used is AODV routing protocol in which the mobile agents moves through the network and updates the routing table according to the node's congestion status. By the simulation results it is observed that this technique attains high throughput and packet delivery ratio with reduced delay and routing load as compared to other existing techniques.

4. SIMULATION RESULTS

The simulation study is done using the network simulator NS-2 version for mobile ad-hoc networks. Simulator Parameters like Number of nodes, Dimension, Routing protocol, traffic etc are given below:

NAME	VALUE
Simulator Used	Ns-2.
Number of nodes	20 & 50
Dimension of simulated area	1000X1000
Routing Protocol	AODV
Simulation Time	60 sec
Traffic type	TCP
Packet size	1000 bytes
Mobility Model	Random walk
Pause time	5sec
Speed	5m/s

The simulations are performed in 1000 x 1000 grid consisting of20 & 50 mobile nodes in the network. The TCP packet size of up to 1000 byte is considered for our analysis. The queue limit is set to 20 packets to avoid frequent drop of packets. Here we are creating congested network which we are doing so by increasing the number of transmission links and mobility speed. We have measured the values of throughput and delay given. Network gets congested when it has higher values for delay and lower values for throughput.

For performance evaluation the following performance standards are used:

1. **Throughput:** This performance metric represents the total number of bits delivered to the higher layers per second.
2. **Delay:** This metric indicates time taken by packet to travel from the source to the destination.
3. **Packet delivery ratio:**It is the ratio of the number of packets successfully received to the number of packets transmitted.
4. **Packet drop ratio:** The ratio of packet lost to the total number of packets used in the network during one transmission phase is defined as packet loss rate.

Below are some simulation results:

Figure1 shows the traffic created in the mobility of the nodes. Number of nodes created in the network are 50 and the communication links is 35. The delay produced from the source to destination through the neighbour nodes.

Figure2 and figure4 shows the result of throughput for 20 & 50 mobile nodes. The mobility speed is taken to be 25m/s for varying communication links 5, 10, 20 and 35. From obtained results, we can see that throughput gradually decreases as we go on increasing the number of communication links in the network. The decrease in throughput ratio in the network indicates that there is congestion in the network and it has to be controlled for successful delivery of the data bits.

Figure3 and figure5 shows the result of throughput for 20 and 50 mobile nodes with varying mobility speed. The mobility speed which has been taken during the analysis is kept at variation of 25, 35, 45 and 55 m/s with 10 communication links. From the results, it is seen that throughput decreases as we go on increasing mobility speed. An increase in mobility speed degrades the performance of the network. Illustrates increase in delay with number of communication links in the network. For better performance there must have minimum values of delay and maximum throughput values.

From the above results we can see as the parameters like communication link and mobility speed are increased we find that there is a change in the performance metrics. The metric throughput keeps on decreases as we go on increasing the mobility speed and communication links in the network and delay for the network slowly goes on increasing. The above results show that network is a congested network and it needs to be controlled. In the following topic we propose the algorithm for the congestion control for mobility models. The following model will try to decrease the congestion occurring in the network.

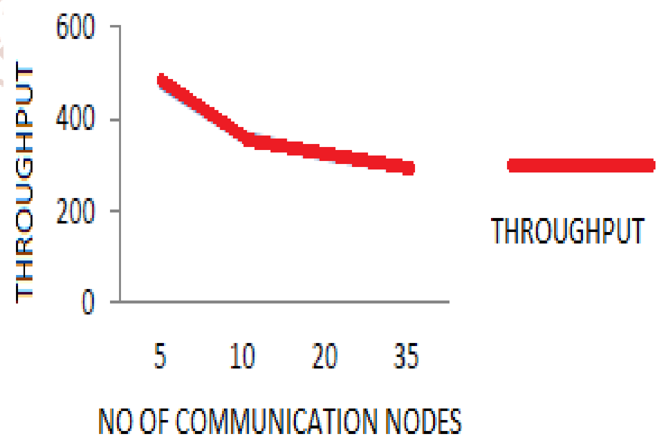


Figure: 1 Throughput vs Congestion graph for given number of communication links for 20 mobile nodes

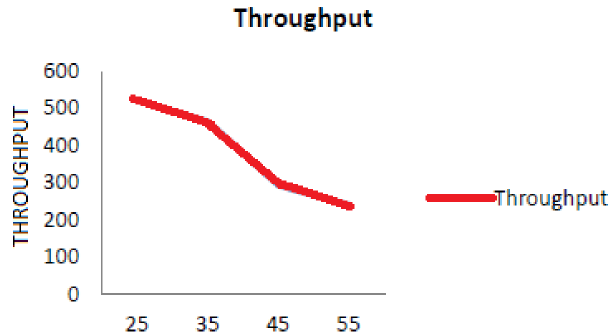


Figure 2: Throughput vs Congestion graph given number of mobility speed for 20 MN

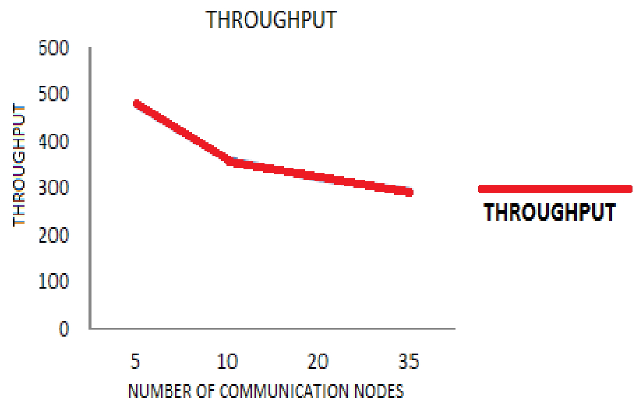


Figure 3: Throughput vs Congestion graph for given number of communication links for 50 mobile nodes

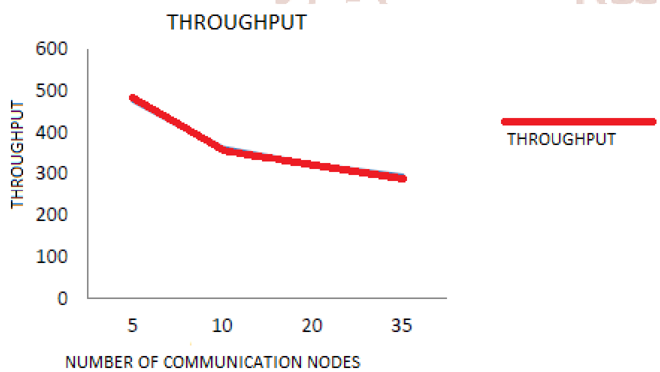


Figure 4: Throughput vs Congestion graph for given number mobility speed for 50 mobile nodes

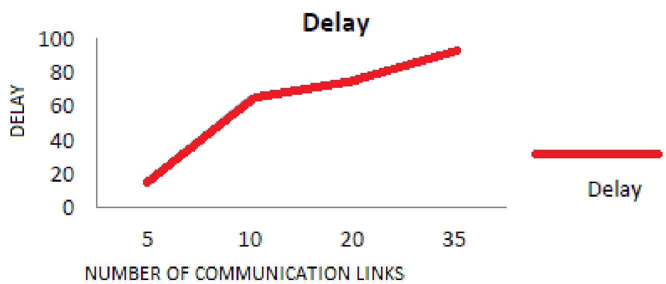
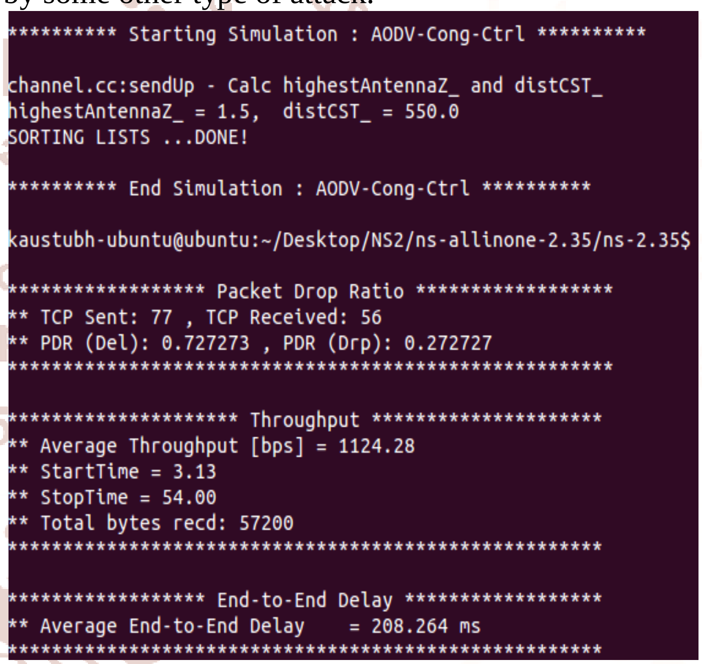


Figure 5: Delay vs Congestion graph for given number of communication links for 50 mobile nodes.

5. The PROPOSED CONGESTION CONTROL MODEL

The proposed model represents the congestion control algorithm for the mobility models i.e. random walk mobility model and levy walk mobility model. The packet drop ratio and the threshold value for packet drop ratio are calculated time to time during commencement of algorithm. The threshold values can be received by calculating the average values for packet drop ratio in the algorithm. If the values for delay keeps ascending above the threshold level and the value for throughput keeps descending below threshold level then it is clear that our network is congested, if it doesn't then it will be a stable congestion free network. If the network is congested then it will calculate the buffer space, load and the available channel capacity in the network. When the congestion is controlled only then process would stop, or else we must consider that the congestion is caused by some other type of attack.



```
********** Starting Simulation : AODV-Cong-Ctrl **********

channel.cc:sendUp - Calc highestAntennaZ_ and distCST_
highestAntennaZ_ = 1.5,  distCST_ = 550.0
SORTING LISTS ...DONE!

********** End Simulation : AODV-Cong-Ctrl **********

kaustubh-ubuntu@ubuntu:~/Desktop/NS2/ns-allinone-2.35/ns-2.35$

***************** Packet Drop Ratio ******************
** TCP Sent: 77 , TCP Received: 56
** PDR (Del): 0.727273 , PDR (Drp): 0.272727
*****************************************************

******************** Throughput ********************
** Average Throughput [bps] = 1124.28
** StartTime = 3.13
** StopTime = 54.00
** Total bytes recd: 57200
****************************************************

***************** End-to-End Delay *****************
** Average End-to-End Delay     = 208.264 ms
****************************************************
```

6. Future Work

In this paper we made the analysis of the congestion control algorithm by analysing its various parameters with 20 nodes and 50 nodes. But in our future work we will dealing with various problems occurring in MANET congestion like common path for two sources how we can deal with such problems and also develop a new algorithm which will control the congestion dynamically by sending message to the source node about sending packets at less no rate that can be handled by the particular node which would result in developing more efficient MANET network.

REFERENCES

1. Fan Bai, Ahmed Helmy. *A Survey of Mobility Models in Wireless Ad-hoc Networks.* University of Southern California.

2. Tracy Camp, Jeff Boleng, Vanessa Davies, 2002. *A Survey of Mobility Models for Ad-hoc Network Research.* IEEE

3. Barkha Shakya, Deepak Kulhare, ArpitSolanki, 2013. *Investigation of TCP Congestion Control with Reliable Communication Techniques for MANET* .International Journal of Computer Applications Vol 65 No-14.Pp 0975-8887.

4. JeroenHoebeke, Ingrid Moerman, Bart Dhoedt, Piet Demeester. *An Overview of Mobile Ad-hoc Network: Applications and Challenges*. IEEE.

5. Ivan Stojmenovic, 2002 "Mobile Ad-hoc Networks and Routing Protocols," in *Handbook of Wireless Networks and Mobile Computing, 2nd* ed. John Wiley & Sons

6. Madiha Kazmi, Muhammad Javed, 2011. *An overview of Performance Comparisons of Different TCP Variants in IP Networks.* Network Digital Technologies Communications in Computer and Information Science.

7. K. Fall, S. Floyd. *Simulation Based Comparison of Tahoe, Reno and Sack TCP*.

8. Parminder Kaur, Ranjit Singh, 2013. *A systematic Approach for Congestion Control in Wireless Ad-hoc Networks.* International Journal of Advanced Research in Computer and Communication Engineering, Vol2 Issue 3.

9. Vishnu Kumar Sharma, Dr Sarita Singh Bhadauria, 2012. *Agent Based Congestion Control Using AODV Routing Protocol Technique for Mobile Ad-hoc Network.* International Journal of Wireless and Mobile Networks.

10. Boraiah Ramesh, 2008. *CA-AODV Congestion Adaptive AODV Routing Protocol for Streaming Video in Mobile Ad-hoc Networks.* I.J Communications, Network and System Sciences.

11. Zequn Huang, Jaeil Jung. *Energy Efficient Congestion Control Technique for Wireless Sensor Networks.* International Journal of Computer Applications.