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A survey on congestion control techniques in MANET

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Abstract
Mobile ad hoc network is established to overcome the limitation of wired networks and infrastructure based wireless networks. Architecture of mobile ad hoc network is very much different from its counterparts. Many issues and challenges are present in mobile ad hoc networks. Link breakage is most frequent due to nodes movement which is the main reason of route failure in MANET. Due to this, transmission of data in ad hoc environment exhibit less network performance. Nodes are self-organizing. These nodes may move freely and change their position dynamically. Congestion control is one of the most challenging task in MANET. Different techniques have been proposed to control congestion in this paper we give an overview over existing methods. The purpose of this paper is to discuss and compare different congestion control techniques.

Keywords: Ad hoc network, multipath, AODV

1. Introduction
A Mobile ad hoc network (MANET) is a collection of wireless mobile nodes which are self-organized, without any existing infrastructure. These networks are fully distributed and be able to work at all position without the assist of any environment. Network topology is dynamic, it means every devices in Mobile Ad hoc Network (MANET) are free to move randomly and organize themselves randomly.

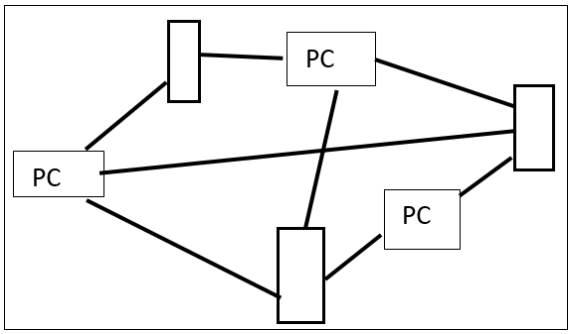

Fig 1: MANET Infrastructure

Rectangles represents mobile phones Mobile ad hoc network are very useful in areas where no infrastructure is available such as battlefield circumstance, disaster relief, and rescue during emergency, discovery etc.
High mobility nature of the ad hoc networks resulted in new challenge that initiate a concept of dissimilarity between wireless nodes. MANET has some disadvantages too e.g. limited resources, less physical security, mutual trust between internal nodes are more vulnerable to be attacked.

1.1 Congestion in MANET
Congestion is defined as a network state link carries so much data that it may deteriorate network service quality. In other words when number of data packet is greater than the capacity of the network than network is called congested. MANET provides transformation of information among the multiple disconnected network or mobile users. In MANET each node works as router and communicate with each other successfully delivering the data. Data packets are forwarded by intermediate nodes, if these nodes are not able deliver all the packets with the same arrival rate make a queue for storing packets for short period of time and wait for their turn. Congestion is exist in all network but to deal with this problem in wired network is easy compared to the ad hoc network. In MANET congestion control techniques do not apply to the network, because of limited resources.

1.2. Congestion control in MANET
Congestion control is one of the major issue in MANET because of its no infrastructure. When the incoming load increases, the network throughput is also increases. When load becomes equals to the network capacity, then throughput not increase instead of these response time starts increasing because of the packet drops.
There are several reasons that may cause packet drop:
- Packet can be drop due to transmission error.
- Dynamic network topology.
- Packet arrival rate exceeds the outgoing link capacity.

1.3 Major performance parameter
The major performance parameter are

A. Packet Delivery Ratio (PDR): The ratio of the number of deliver data packets to the destination. This illustrate the level of delivered data to the destination. The PDR is a number ranges between 0 and 1. It is represented in percentage.
Then
PDR=∑Number of packet receive / ∑Number of packet send.

The greater value of packet delivery ratio means the better performance of the protocol.

B. Throughput: Throughput is the rate of successful message delivery over a communication channel. Throughput is measured in bits per second.
Let T is the unit time that is measure in milliseconds. N is the number of packets which has been received in T.
Then throughput =N/T millisecond

C. Routing Overhead: Routing overhead defines as the traffic occur in the communication link. Routing packet
Contains routing information send by sender.

D. End-to-end delay: the average time taken by a data packet to arrive in the destination. It also includes the delay caused by route discovery process and the queue in data packet transmission. Only the data packets that successfully delivered to destinations that counted.
End to End delay=
$\sum$ (arrive time –send time)/
$\sum$ Number of connections
The lower value of end-to-end delay means the better performance of the protocol.

E. Packet lost: the total number of packets during simulation.
Packet lost= Number of packet send – Number of packet received.
The lower value of the packet lost means the better performance of the protocol.

2. Congestion control techniques

2.1 Cluster based congestion control technique

S. Karunakaran *et al*. [1] 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 proposed approach improves the responsiveness of the network as compare to conventional mechanism. Sending rate is adjusted according traffic rate along path

2.2 Trust routing protocol based congestion control in MANET

Rahim Rashidi *et al*. [2] proposed trust based congestion control protocol that consist of routing protocol based on trust, the paths are not done according to the security. In order to do this nodes are created in the paths which have more trust than to other nodes. The trust models presented before have three main properties of the trust agent, reputation agent and combiner agent. Since the congestion control agent is crucial in the trust protocols, this article presents a developed trust protocol based on congestion control. In the presented model, the congestion control section guarantees the stability of network and does the distribution of the load on the most highly trust nodes.

2.3 Investigation of TCP congestion control with reliable communication in MANET

Barkha Shakya *et al*. [3] proposed TCP congestion control with reliable communication that uses enhance TCP techniques to get improve result of tcp previous techniques and eliminate the congestion from the network. this provide reliable as well as efficient communication, for that purpose create a TCP socket and transmit data from sender to receiver and measure the end-to-end delay as well as normal time acknowledge delay difference and store it, after second scenario create number of TCP sender and receive all share common mobile node, in that case particular node is heavy loaded and creates congestion but this is unavoidable. Each time sender compute acknowledgement delay difference and compare it to normal time acknowledgment delay difference, if t increases then sender change the data rate.

2.4 Early detection congestion and control routing in MANET

T Senthil Kumaran *et al*. [4] proposed early detection congestion and control routing. The proposed protocol presents the early detection of congestion and control routing mechanism for wireless ad hoc networks called EDAODV. EDAODV maintains queue. By identifying queue status and congestion status EDAODV identified congestion. Based on the congestion status, it identifies the non-congested predecessor and successor nodes of a congested element and start finding route bidirectional to find alternative path between them. The proposed scheme improves the packet delivery ratio and end-to-end delay.

2.5 Multipath load balancing and rate based congestion control for MANET

Soundararajan, S. and R.S. Bhuvaneswaran [5] proposed a new approach Multipath Load balancing and rate based congestion control (MLBRBCC). MLBRBCC is based on rate control mechanism for avoiding congestion. In which destination node forwards feedback to the sender. This feedback contains estimated rate from the intermediate nodes. On the basis of this feedback sender adjust its sending rate. Simulation results show that proposed mechanism has better packet delivery ratio and improved throughput.

Table 1

Parameter	In comparision with AODV				
Technique	**Packet Delivery Ratio**	**Throughput**	**Routing Over-head**	**Average End-to-End delay**	**Packet Drop**
Cluster Based Congestion Control	Increase	No Effect	Decrease	Decrease	No Effect
Trust Routing Protocol Based Congestion Control	No Effect	Increase	Decrease	No Effect	No Effect
Investigation Of TCP Congestion With Reliabl Communication	Increase	Increase	Decrease	Decrease	No Effect
Early Detection Congestion And Control	Increase	No Effect	No Effect	Decrease	No Effect
Multipath Load Balancing And Rate Based	Increase	Increase	No Effect	No Effect	No Effect

3. Conclusions

This paper presents a survey on the congestion control technique for MANETs. We briefly overviewed and discussed each mechanism of congestion control in MANET. We also compared the mechanism based on different parameters.

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