An approach for Congestion Control in Mobile Ad hoc Networks

Saurabh Sharma [#1], Dipti Jindal [#2] Dr. Rashi Agarwal [#3]

#1 Research Scholar, Sharda University, Gr. Noida, 07830202777 and sam7sai@gmail.com
#2 Asst. Prof, Skyline College, Noida, 80100697711 and dipti.gupta07@gmail.com
#3 Associate Prof., Sharda University, Gr.Noida, 09410899287 and rashi.agarwal@sharda.ac.in

ABSTRACT

This paper concentrates on the study of the congestion control techniques in wireless networks. These networks may be the simple networks or ad hoc network or most typical Mobile Ad hoc network, as nodes are movable in them. The main problem faced by MANETs is of congestion. The frequent changes of the network topology and shared nature of the wireless channel pose significant challenges to deal with the congestion in MANET. This paper suggests a comparative analysis between the clustering; queuing and cross layer protocols for congestion control and suggests an idea to overcome it.

Key words: Congestion control, MANET, RED, Queuing.

Corresponding Author: Saurabh Sharma

1. INTRODUCTION

Ad hoc networks are self-organizing wireless network, which do not rely on fixed infrastructure or on predetermined connectivity. Mobile Ad-hoc Networks (MANETs) are composed of a set of communicating devices which are able to spontaneously interconnect without any pre-existing infrastructure [6]. Mobile ad hoc networks (MANET) are the infrastructure- less networks where the nodes keep moving randomly at varying speeds that result in continuously changing network topologies. This paper mainly emphasised the congestion problem and the main techniques used for it [12].

Due to this changing network topology various issues have been observed, in which congestion is one of the problem. Congestion is caused when the offered load to the network is more than the available resources. An ample of work has been done on Congestion control in MANET. In this survey paper we consider the problem of congestion control in mobile ad-hoc networks

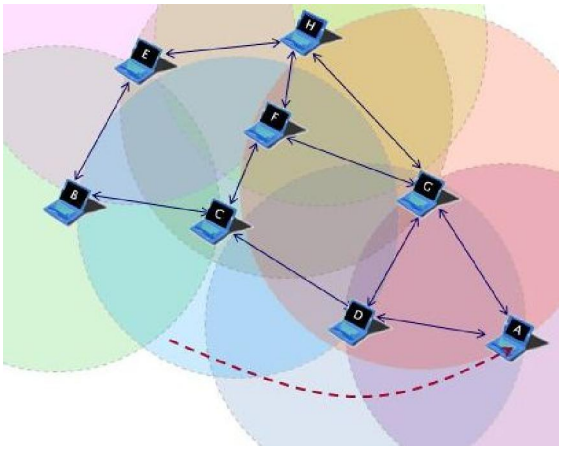

Fig. 1 MANET

2. PROBLEM STATEMENT

Whenever the offered load to the network is more than the available resources then this state leads to congestion. Congestion in network can severely deteriorate network throughput and can lead to network collapse.

A network like MANET which uses shared resources and where multiple senders have to compete for link bandwidth, it is necessary to adjust the data rate used by the sender in such a way that the network should not be overloaded.
An ample of work has been done on Congestion control in wired network. Some of the approaches used in wired networks are TCP fast start by Padamanabhan, V N, et al [6], Random Early Detection (RED) by Floyd [7], Adaptive RED (ARED) by Feng W. et al [10], revised ARED by Floyd S. et al. [5] etc.

2.1 Congestion in MANETS

All the above techniques works well on the Internet, but as we know that MANETs exhibit some unique properties that greatly affect the design of appropriate protocols of a congestion control mechanism as the network is formed of the mobile nodes which change their positions unknowingly. As shown in the fig. 1 that the node 'A' has changed its position elsewhere

3. CONGESTION CONTROL TECHNIQUES

An ample of work has been done on Congestion control in MANET earlier and various approaches have been examined and a new one proposed to solve the issue. This paper includes the following approaches for comparison: Queuing techniques, Cluster based congestion control technique, cross layer congestion control.

3.1 Cross Layered Approach for congestion Control

The problem of congestion control in ad-hoc wireless networks is addressed by Antonopoulo C.et al [3]. It identifies that the cause for performance degradation in wireless network is excessive congestion. For such networks the utilization of the cross-layer design approach is advocated. They also argued that the layered approach of the OSI/ISO model is not sufficient enough to provide substantial performance enhancement in wireless networks with dynamic nature.

Kliazovich et al. presented a Cross-layer congestion control (C3TCP) [9] scheme which measures the bandwidth and delay at link layer to obtain high performance. The measurements are stored in feedback field which are gathered hop by hop from the intermediate When an ACK is generated at the destination node the feedback included in the corresponding data packet is repeated and thus transmitted back to the sender. C3TCP is dynamically limiting the window size of the sender based on the measurements. In order to keep the TCP implementation unmodified, all C3TCP logic is contained within the additional protocol module.

Yu in [10] observed that in explicit link failure notification, a number of data packets and ACKs may get lost before the state is frozen which leads to missing packets or missing ACKs after the state is restored. These missing packets or missing ACKs will then cause timeouts or duplicate acknowledgments. Yu presents a cross-layer information awareness scheme to overcome this by extensively using cached route information from the DSR routing protocol. Yu presented two mechanisms i.e., Early Packet Loss Notification (EPLN) and Best-Effort ACK Delivery (BEAD). EPLN notifies the TCP senders about the sequence numbers of lost packets then the sender disable the retransmission timer and retransmit the respective packets upon route reestablishment. ACK loss notifications are generated by BEAD at intermediate nodes and send them towards the TCP receiver. This prevents ACKs from being permanently lost. A node forwarding such a loss notification may send an ACK with the highest affected sequence number to the TCP sender if it is able to do so. Otherwise the TCP receiver will retransmit an ACK with the highest sequence number when a new route is present..

3.2 Queuing Approach for Congestion Control

Xu K. et al in [4] proposed NRED (Neighborhood RED) scheme, which is an extension of original RED [11] developed for wired networks. NRED brings the concept of distributed neighborhood queue. This scheme is able to improve TCP fairness by detecting early congestion and dropping packets proportionally to flow's channel bandwidth usage. In NRED [4], every node estimates the number of packets queued in its neighborhood. If the length of this queue exceeds a threshold, packets start getting dropped with increasing probability. Steps involved in NRED

1) Neighbourhood queue size estimation, it is done by analyzing the channel utilization. If the utilization exceeds a threshold the neighborhood is presumed to be in an early congested state.

2) Calculate the drop probability and is sent explicitly to all neighbors.

Calculation of drop probability by each node is based on the received notifications. Incoming packets are dropped with this local probability.

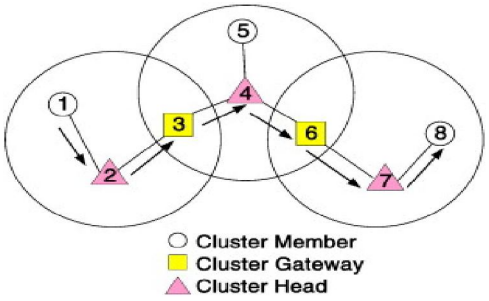

Fig. 2 Cluster Head Queuing

3.3 Cluster Based Congestion Control

Prof. P. K. Suri et.al in [2] present a table driven routing protocol named CBQR (Cluster Based Routing Protocol) to handle the issues of bandwidth efficiency by using cluster-head. As shown in the table (1) the results which are made through the clustering based techniques and queuing based are different from the routing based work.

The results for different approaches are compared in the table below in figure 3. And it has been observed that the results for the clustering improves it 10%, Queuing approaches 11% and the others by 7% approximately [9], [10], [11].\

Approach for Congestion	*Author and Year*	*Research Topic*
Cross Layered approach	Christos Antonopoulo and Stavros Koubias, 2010	Congestion Control Framework for Ad-Hoc Wireless Networks
	D. Kliazovich and F. Granelli, 2006	Cross-layer congestion control in ad hoc wireless networks
	X. Yu, 2004	Improving TCP Performance over Mobile Ad Hoc Networks by Exploiting Cross-Layer Information Awareness
Queuing Approach	Z. Fu, P. Zerfos, H. Luo, S. Lu, L. Zhang, and M. Gerla, 2003	The Impact of Multihop Wireless Channel on TCP Throughput and Loss
	K. Xu, M. Gerla, L. Qi, and Y. Shu, 2003	Enhancing TCP fairness in ad hoc wireless networks using neighborhood RED
Clustered Approach	M.J. Handy, M. Haase and D. Timmermann, 2002	Low energy adaptive clustering hierarchy with deterministic cluster-head selection
	S.Karunakaran & P.Thangaraj 2010	A clustered based congestion control protocol for mobile ad hoc networks
	Prof. P.K. Suri, Dr. M. K.Soni, and Parul Tomar, 2010	Cluster Based QoS Routing Protocol for MANET
	W. Almobaideen, K. Hushaidan, A. Sleit, Mohammad Qatawneh,2011	A Cluster-Based Approach for Supporting QoS in Mobile Ad Hoc Networks

Table 1: Comparing Different Approaches

4. PROPOSED MODEL

The congestion in an ad hoc network can be traced to the entire space around the node because in ad hoc network node has to compete for the channel requirements with the nodes that lie in the same space using MAC protocol. "Neighbourhood" is the name given for this "space" in [4].

In this paper a novel scheme is suggested having hybrid model to be applied on the cluster gateway/head in the clustered network [12]. Cluster-head contains the information of its member node as well as of other cluster-heads, becomes the reason why we apply this method on cluster-heads. It will also reduce the bourdon from the member nodes, in a cluster, of calculating the average queue size or we can say channel utilization. The queue size on the cluster-head nodes determines the degree of congestion in network. For this, first we have to choose the cluster-head.

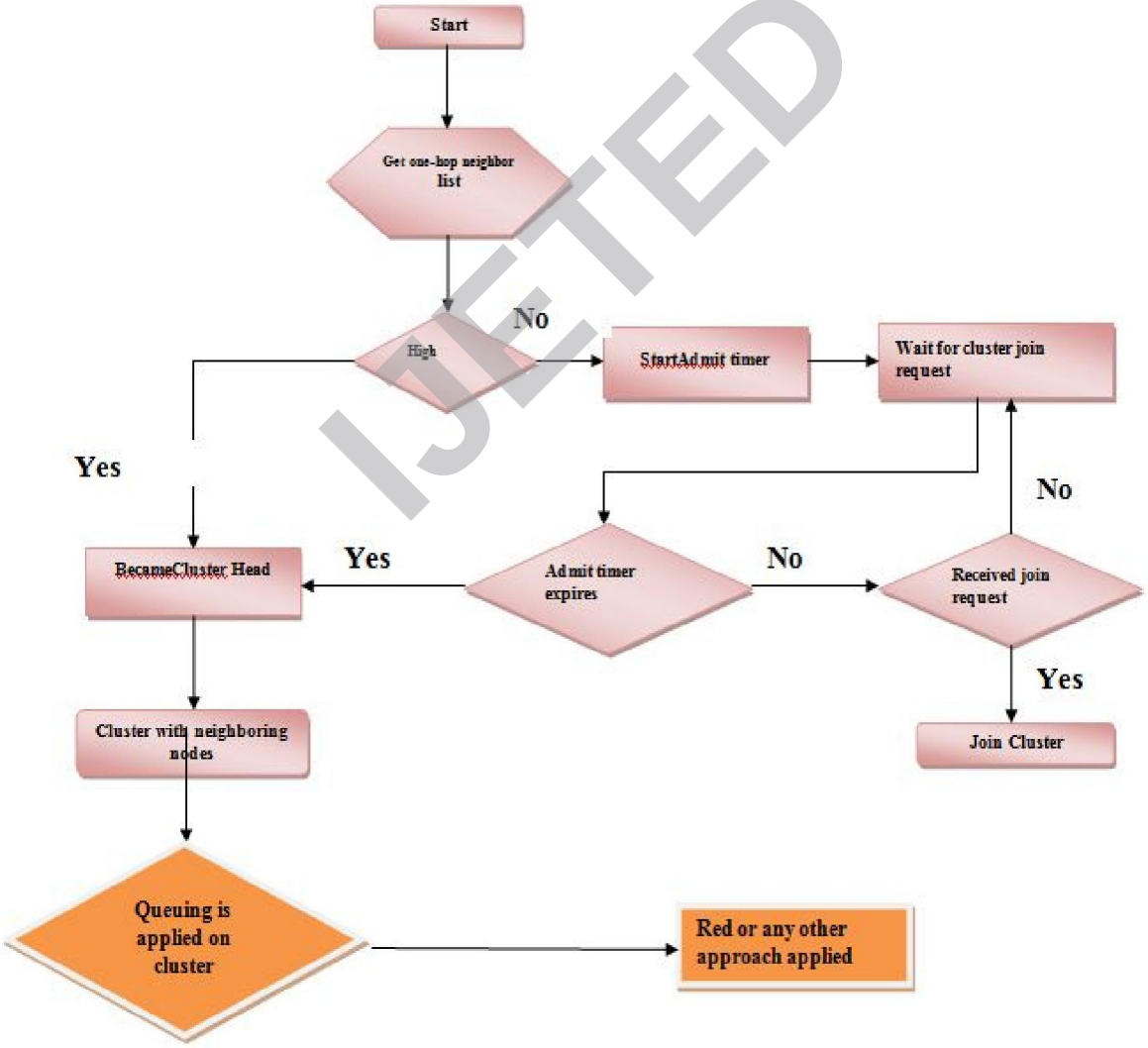

Fig. 3 Flow Chart for Proposed Model

5. COMPARATIVE STUDY

As it has been examining in this paper that the different approached gives different improved results. The comparison between the different approaches has been done and it is shown in the table below. As it has been shown in the Fig. [1] that the MANETS have mobile state. Thus, the approaches examined also gives the results such that by using the Clustering the results are improved by 10 %, by using queuing results are improved by 11% and the results for the cross layer protocols by 7%.

So, any of the approaches alone may not give the results as needed. It is an approximation that if we go through with our approach the results may be improved with the hybrid model.

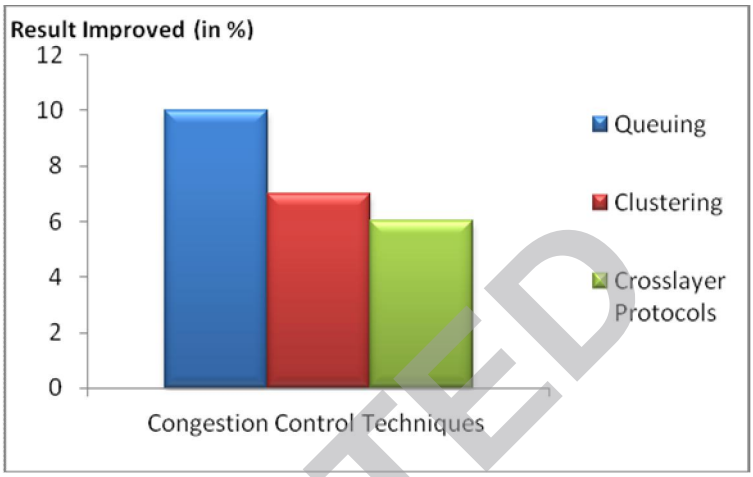

Figure 4 Comparison in between the Existing techniques

6. CONCLUSION

The above study concluded that the mobility and ad hoc nature helps in strengthening the congestion but, the clustering and queuing simultaneously diminishes the effect of mobility as well as ad hoc nature as shown by the results. But, different approaches like queuing, clustering and different protocol are able to cop up with this problem. This comparative study and the proposed approach which is a hybrid model is assumed to be improve the results as it has been left for the future work.

REFERENCES

[1] J. Chen, C. Hu, and Z. Ji, "An improved ARED algorithm for congestion control of network transmission," *Mathematical Problems in Engineering*, vol. 2010, Article ID 329035, 14 pages, 2010.

[2] Prof. P.K. Suri, Dr. M. K.Soni, and Parul Tomar, "Cluster Based QoS Routing Protocol for MANET," *International Journal of Computer Theory and Engineering*, vol. 2, no. 5, October, 2010.

[3] Christos Antonopoulo and Stavros Koubias, "Congestion Control Framework for Ad-Hoc Wireless Networks," *Wireless Personal Communication*, vol. 52, pp.753-775, 2010.

[4] K. Xu, M. Gerla, L. Qi, and Y. Shu, "Enhancing TCP fairness in ad hoc wireless networks using neighborhood RED," in *Proc. ACMMobiCom*, pp. 16–28, 2003.

[5] S. Floyd, R. Gummadi, and S. Schenker, "Adaptive RED: an algorithm for increasing the robustness of RED's active queue management," *Technical Report*, 2001, http://www.icir.org/floyd/papers/adaptiveRed.pdf.

[6] Tomas Krag and Sebastian Büettrich (2004-01-24). "Wireless Mesh Networking". *'Reilly Wireless Dev Center'.* http://www.oreillynet.com/pub/a/wireless /2004/ 01/22/

[7] Venkata N. Padamanabhan and Randy H. Katz, "TCP Fast Start: A Technique for Speeding Up Web Transfers," in *Proc. of IEEE Globecom'98 Internet Mini-Conference*, November 1998.

[8] S. Floyd and V. Jacobson, "Random Early Detection Gateways for Congestion Avoidance," *IEEE/ACM Transactions on Networking*, 1(4):397–413, Aug. 1993.

[9] D. Kliazovich and F. Granelli, "Cross-layer congestion control in ad hoc wireless networks," *Ad Hoc Networks*, 4(6):687–708, Nov. 2006.

[10] X. Yu. "Improving TCP Performance over Mobile Ad Hoc Networks by Exploiting Cross-Layer Information Awareness," In *MobiCom '04: Proceedings of the 10th annual international conference on Mobile computing and networking*, pages 231–244, New York, NY, USA, 2004..

[11] S.Karunakaran & P.Thangaraj , "A cluster based congestion control protocol for mobile adhoc networks" , *International Journal of Information Technology and Knowledge Management* , , Volume 2, No. 2, pp. 471-474, July-December 2010.

[12] S. Sharma, Dr.R Agarwal,. "Analysing Qos Parameters In MANETS: A Survey, *Second International Conference on (RTSTMSD-15), Recent Trends in Science, Technology, Management & Social Development*, pp. 82-89, 2015