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A REVIEW ON CONGESTION CONTROL METHODS IN MOBILE ADHOC NETWORKS

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Abstract - *MANET (Mobile Ad hoc Network) is a type of ad hoc network, which consists of mobile devices as the nodes in the network. There will not be any centralized infrastructure. It has many features like multihop communication, dynamic topology. But it has limited resources and limited security. The limitations in resources may cause congestion in the network. Congestion may occur in any intermediate nodes and results in high packet loss, high delay which lead to performance degradation of the network. So congestion control is one of the importance tasks in the MANET. This paper presents a review of different techniques used for the congestion control in the MANET.*

Key Words: MANET, Multi-hop, Topology change, Congestion Control, Packet loss

1. INTRODUCTION

MANET's were earlier named as packet radio. MANET is a collection of mobile devices that are connected over various wireless links. It is a infrastructure less networks of mobile devices connected without wires. Each device in a MANET is free to move in any direction, and will therefore change its links to other devices frequently. A node in the network can communicates directly with other nodes within its wireless communication range. If the destination node is beyond the communication range of the source node, then the intermediate nodes act as routers to forward the packets from the source to destination. Each node in the MANET act as both router and host. That is it is autonomous in behaviour. MANET has many features like dynamic topology, self-configurability, flexibility and multi-hop communications. Due to these features they are used in various kinds of applications like military applications, rescue operations, vehicular networks etc. But MANET has limited resources and security.

One of the major problems in the MANET is the congestion. Due to the limited availability of the resources and the nature of the network the congestion become the common issue in the MANET. Congestion occurs in some part of the network when the traffic is too heavy. This problem arises when a router can receive packets on multiple input ports at a higher rate than that it can forward. Due to shared wireless channel and dynamic topology, packet transmissions suffer from interference and fading. Congestion causes packet loss, bandwidth degradation, and time and energy wastage. So congestion should be controlled.

2. LITERATURE SURVEY

In this section different method for congestion control in MANET is discussing.

In 2019 Navneet Kaur and Rakesh Singhai proposed a fuzzy controlled data rate based and hello interval based congestion control method [1]. The data rate and control packets such as Hello packet interval is selected according to the channel conditions depending on the node mobility and energy consumed by the nodes in transmission. Depending on the transmission power and current speed of the nodes, the method enables nodes to adjust their data rate and frequency of their Hello messages. This improved protocol detects and reacts to the congestion parts of the network. This will reduce the congestion and improve the throughput. The proposed method enhances the performance of mobile network in terms of parameter throughput, end to end delay, jitter, queue length.

In the same year a novel cross layer approach called congestion adaptive and delay sensitive multi-rate (CADM) routing protocol in MANET [2]. CADM protocol find the route through less congested nodes and congestion is actively handled when it occurs. This method consists of rate adaptation and congestion aware optimization to improve the performance in terms of throughput, packet delivery, and latency. CADM finds a less congested, high throughput route based on QoS metrics data rate, packet forwarding delay and buffer queuing delay.

JiashuaiWang et al. proposed a contention-based hop-by-hop bidirectional congestion control algorithm (HBCC) in 2019 [3]. In this method the congestion is detected using queue length as a parameter. By determining the queue length of current node and next hop node the congestion conditions are divided into four categories. The algorithm adaptively adjusts the contention window of the current node when at least one of the two nodes is congested and also changes the priority of the current node to access the channel. The buffer queue length of the congested node is reduced in this way.

A method called Bandwidth Aware Routing Strategy (BARS) is introduced by Nousheen Akhtar et al. in 2019 to avoid congestion in MANET [4]. In this method the

congestion is avoided by monitoring the residual bandwidth capacity in the network paths and the available space in the queue. The calculation of these parameters are calculated before the transmission of messages. According to the availability of the bandwidth and queue, method will adjust the data rate.

In 2018 Mohsen Yaghoubi Suraki et al. proposed a Fuzzy Cross-Layer congestion Control (FCLCC) [5]. In this paper to avoid the congestion problem a cross-layer approach is proposed in transport, network, and MAC layers in which Fuzzy Logic System is used in intermediate and destination nodes. DSR routing algorithm is used in the network layer and messages that are exchanged among nodes are put into the ACK packets. Detection, notification, and adjustment of the transmission rate are the three features of this method. From the buffer conditions and the number of times that the buffer becomes full, the congestion is detected. In notification step, the congestion level is determined by the fuzzy controller and informed to the upstream nodes. Finally in the transmission rate step, according to the congestion level transmission rate is adjusted.

Saurabh Sharma et al. in 2018 proposed a Mobile Random Early Detection method to control the congestion [6]. The method is based on hybrid approach that uses clustering and queuing techniques. In general cluster head transfers the data and follows a queuing method based on RED (Random early Detection). The mobile environment will make it Mobile RED (MRED). It mainly depends on mobility of nodes and mobile environment which leads to unpredictable queue size.

In 2018 Yefa Mai et al .propose An Effective Multiple Paths Congestion Control AODV (CC-AODV) [7], which lower the performance degradation caused by the packets congestion while the data is delivered using AODV. The method uses a congestion counter label to determine the path for the data. This can be done by checking how stressed the current node in a table. The congestion counter adds one to the counter, once the RREP package is generated and transmitted. The keystone to achieve multiple routing paths is the implementation of the congestion counter in the routing table. CC-AODV will outperform AODV in throughput, packet delivery ratio and packet loss.

A Combined TCP-friendly Rate control (TFRC) with WFQ Approach is proposed by Y. Narasimha Reddy et al. in the year 2018 [8]. In this paper an integrated TFRC with weighted fair queue (WFQ) approach is introduced to overcome the congestion in the network and to minimize the RTTs. The WFQ mechanism will manage the incoming heavy traffic. This is done to ease the data rate control for smooth data flow to improve throughput. This proposed method is mainly based on buffer queue management. It reduces router congestion through proper scheduling of data packets based on packet weights.

Astha Mishra et al. proposed a methodology in 2018 to overcome the congestion and interference in MANET [9]. The congestion and interference is avoided using the multichannel energy based routing approach. This method uses the multichannel-based communication that is single or multiple senders will use more than one channel to send the data. While the multiple senders simultaneously demands the channel from the intermediate nodes, the interference, collision and delay of the network can be minimized by the multichannel wireless mobile ad hoc network.

In 2018 Y. Narasimha Reddy et al. proposes a method for data rate and congestion control [10]. Propose method is a routing delay prediction based on packet loss and Explicit Delay Acknowledgement (EDA) mechanism. The packet rate is controlled through determining the buffer length of each intermediate node in the route to destination. The destination node that receives each data packet, transmit an EDA message with updated buffer length during the current traverse. The method will efficiently control data rate for streaming application to minimize the loss of packets and improve the throughput. This mechanism deals with inconvenience of TCP congestion over MANET.

A. Amuthan et al. [11] in 2018 proposed a Dynamic multi-stage Tandem Queue modeling-based Congestion Adaptive Routing (DTQCAR). The method is based on the estimations of average threshold level of congestion. It is an effective and efficient congestion control method, because it considers current level of congestion level for dynamic packet routing depending on the amount of packets need to be forwarded instantaneously. It has a warning module that sends alert message to interacting neighbouring node for dynamic adjusting of packets that are forwarding.

In 2017 R.Vadivel et al.[12] proposed an adaptive reliable and congestion control routing protocol to avoid congestion and route errors using bypass route selection in MANETs. On the basis of utilization and capacity of link and paths the congestion is detected. Here multiple paths are constructed and among that shortest path is selected for data transmission. When a node detects congestion on outgoing link, it will calculate the multiple paths to the destination. Then some portion of the traffic to the node is shifted to alternate path. The distribution of traffic over alternate path is done by considering the path availability threshold and using a traffic splitting function. The main objective of this method is to minimize the utilization to a more acceptable level by shifting a portion of the traffic to the alternative paths and this part of traffic. Whenever a local link congestion is detected or receives an Explicit Congestion Indication (ECI) bit from a neighbour, then node calculates a set of alternative paths and distributes the bypass traffic over these paths. If one node cannot resolve the congestion, then it signals its neighbors using the congestion indication bit.

During the same year Varun Kumar Sharma et al. [13] proposed an effective cross-layer adaptive transmission method to handle the congestion in mobile wireless ad-hoc networks. The method mainly focuses on minimizing the effects of congestion on the network performance. It based on the estimation of congestion intensity experienced by a node. The proposed method successfully classifies packet losses in the network to prevent unnecessary adaptations of transmission rates. The method also identifies the contribution of each flow in congestion intensity and selectively makes significant congestion contributors to adapt their transmission rates.

Sujata V. Mallapur et al. [14] I 2017 proposed an efficient routing technique called the multipath load balancing technique for congestion control (MLBCC) in MANETs. It efficiently balance the load among the multiple path by reducing congestion. MLBCC introduces two mechanisms called congestion control mechanism and load balancing mechanism during the transmission of data. Arrival rate and outgoing rate in a particular interval are used to detect congestion in the congestion control mechanism. By using the link cost and the path cost the load balancing mechanism selects a gateway node that efficiently distribute the load by selecting the most desirable paths. The selection of gateway node is done such that it possesses good link status while minimizing the total path cost. When candidate node detects a load, the packets are immediately fragmented and the load is distributed through the selected gateway node. The gateway node efficiently distributes the traffic by selecting three useful paths. Here a node availability degree standard deviation parameter is introduced for an efficient flow of distribution.

In 2017 Nousheen Akhtar et al. [15] proposed AODV based mechanism to avoid congestion before happening. The available bandwidth is adjusted according to the estimated current bandwidth consumption. Available bandwidth is predicted using the HELLO messages. A feedback is provided to the source node about the current network state. According to this current network state the source node adjusts its data rate.

3. CONCLUSION

This paper gives an overview of different methods used for the congestion control in MANET. In ad-hoc networks congestion is the main issue. In MANET the nodes are moving so that there will be topology changes, these types of features results in the congestion of the network. The congestion mainly occurs when the packets arriving to the network exceeds the capacity of the network. Due to congestion there will be performance degradation of the network. Different types of mechanisms are introduced to control the congestion. Each mechanism improves the overall performance of the network, enhances the throughput, packet delivery ratio and decreases the packet loss and delay.

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