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CONGESTION CONTROL IN WMNS - A SURVEY

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ABSTRACT

WMN is one of the emerging areas of research for next-generation wireless networking. WMN rely on high mobility and dynamic topology of nodes. WMNs are widely used in many application sectors such as broadband home networking, community networking, and enterprise networking. However, due to factors like change in topology, traffic characteristics of flows, channel capacity and available transmission rate causes congestion in network which leads to packet loss in data transmission. Congestion is one of the major reasons behind link breakage due to excessive loads on the network. In this paper we address various congestion control techniques used so far in WMN.

Keywords: AODV Protocol, Congestion, Routing, WMNs.

I. INTRODUCTION

Wireless Mesh Networks are infrastructure less type of networks. WMN is a communication network consisting of Mesh routers and Mesh clients. Each node not only works as host but also as router to forward packets on behalf of other nodes which are out of coverage. As WMN is a self organized network, nodes automatically create mesh network. Nodes communicate with each other by transmitting data packets over multiple wireless hops. Mesh routers act as backbone for Mesh clients [1]. Routing in WMN occurs by forwarding packets on the best possible path which is determined by routing protocol. But contention and congestion has made the routing difficult. Congestion is when load on network is more than its capacity. This happens because routing protocol uses same best path for every packet. Congestion deteriorates the network performance by not allowing packets to reach at destination on time or losing some of the packets. This can be controlled by using some specific congestion control methods. These methods found a path which is optimum as well as congestion free.

This paper discusses Congestion. Congestion is when sending rate of packets is much more than the receiving rate of destination node or intermediate nodes. So the congestion control algorithm finds the queue length in each path and based on that optimum path is selected [4].

The rest of the paper summarizes as follows. Section 2 explains popular routing protocol AODV. Section 3 describes the Congestion problem in WMN and Section 4 gives a review on various techniques. Last section concludes the paper.

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II. AD HOC ON DEMAND DISTANCE VECTOR ROUTING PROTOCOL

Routing protocol defines the set of rules to be followed while routing the message from source node to destination node either on-demand or by maintaining information in the form of table or using the combination of both. AODV is a reactive on demand routing protocol. It establishes route whenever source wants to transmit data. To keep fresh routes AODV uses sequence numbers. It works in two phases. One is route discovery and establishment and other is route maintenance. Route discovery process starts with broadcasting RREQ message. AODV routing protocol maintains a routing table which contains the information about its neighboring nodes and information about fresh route to the destination. If the source node has fresh route to the destination it uses that route otherwise initiate route discovery process. The destination node or intermediate node having fresh route to destination replies with RREP message. After receiving RREP message, sender sends its data or packets through that route. if there is any link breakage in the path to destination, neighboring node sends a RERR message to the source node. After this source node re-initiates the route discovery process.

III. CONGESTION IN WMN

Congestion is major issue in WMN along with the security issue. This is basically the instability of the network due to the unfair access of the network by mesh nodes. Densely deployed network causes the congestion which leads to packet drop and late delivery of packets. Nodes in the network uses shared resources like link bandwidth. When different senders compete for the same path, it is necessary to adjust the bandwidth for each sender so that packets can be transmitted without any loss. But it is very crucial for senders to adjust the resources so packet which are not reached at the destination need to be retransmitted. These packets had already consumed so many resources by travelling in the network and now this retransmission exceeds the control packets in network causing network deterioration [4]. If congestion control algorithms are not used then network may collapse. Most of data reaches the Internet through gateway, so congestion mostly occurs near the gateways and less at other intermediate places. In Wireless Mesh Networks, routing protocols play important part. Because firstly routing protocol finds the suitable optimum path for transmission then packets are transmitted through that path. But the real problem arises when routing protocol finds the same best path each time for the same destination causing congestion problem which leads to the packet loss, late delivery of packets and bandwidth wastage. This problem becomes intense in case of multimedia data transmission. Hence the main reason of congestion is reduced throughput of nodes and overflow of the buffers or queues temporarily holding the data packets before the nodes. When routing protocol is not aware of congestion in the network causes severe damage to the quality of service of the network.

IV. VARIOUS TECHNIQUES EMPLOYED SO FAR FOR THE CONTROL OF CONGESTION IN WMNS

4.1 Congestion Adaptive Routing Protocol for Mobile networks

Authors described that for controlling the congestion; routing protocols should not only be aware of congestion in path but also be adaptive enough to overcome this situation. For this they introduced a protocol named CRP

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i.e, Congestion Adaptive Routing Protocol. In this mechanism, the protocol always determines two paths to destination. One is called primary and other bypass path. When a node finds path to be congested, it warns its previous node about it and by pass the traffic to the non congested path. Thus this protocol works in six phases: Congestion monitoring, primary path discovery, by pass path discovery, Traffic splitting and Congestion adaptability, Multipath minimization and Failure recovery. The simulation results prove that there is improvement in throughput and end to end delay while having little overhead. CRP is an On-Demand routing protocol but it is an energy efficient protocol as compared to AODV and DSR [2].

4.2 Priority Based Congestion Control Routing in Wireless Mesh Network

In this technique priority based optimum path is selected. The congestion problem is when routing protocol determines the same best path for each sender and other alternatives paths are rarely used. So priority based algorithm is used to overcome this problem and improves the network performance. In this technique before starting any communication routing protocol finds all possible paths from source to destination and stores their information in the routing table. Since this is a wireless network so every time nodes change their position their individual paths also change. So there need a change in routing table also. After all possible paths are found algorithm assigns priority to each path based on the number of intermediate nodes in the path or length between sources to destination. Based on the priority of the individual paths traffic is distributed on different paths in the form frames. Communication is always started from the highest priority route and traffic is distributed to second highest priority route after specific interval of time [9].

4.3 Efficient Bandwidth Utilization with Congestion Control for Wireless Mesh Networks

Congestion degrades the network performance by excessively using network bandwidth. Congestion control plays an important part in improving system performance and network bandwidth. In this mechanism firstly available bandwidth is measured and based on that data is transmitted through different routes. This technique works as follows: firstly a mesh network of nodes is created and available bandwidth is calculated using technique called probing. In this control packets are sent in the network continuously for calculating bandwidth based on the factors like traffic, probe return time, queue length etc. Based on this bandwidth of the network is decided. After this efficient bandwidth congestion control algorithm works. If bandwidth indicates congestion then ECN (Explicit Congestion Notification Scheme) is used to notify the congestion in the network. If congestion is greater than critical threshold then congestion control scheme is used otherwise data packets are queued and are successfully transmitted to the receiver [8].

4.4 Performance Enhancement of Routing Protocol using AQM in WMNs

This mechanism introduces an Active Queue Management method for enhancing the network performance. Most of the previous researches are done to either optimize end to end hop count or efficient energy management route. But this mechanism is to optimize the buffer or queue using AODV protocol. With this technique buffer overflow and packet loss can be reduced. This algorithm firstly identify whether the congestion is due to link failure, buffer overflow or node mobility. In this red buffer is implemented as input buffer to store and forward packets. Calculations are made to check the status of buffer of router. If it is below the threshold value then packets are routed as it is and no packet drop occurs. Otherwise packets are routed through priority

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input buffer. So this algorithm basically works on the effective management of the Queue to improve the performance and to get rid of congestion [5].

4.5 Congestion Reduction in Wireless Mesh Networks with buffer management

In this technique authors have designed an algorithm which is based on the threshold value of the buffer. This algorithm not only prevents the congestion in the network but also alleviate the impact of congestion throughout the network. In this algorithm after the establishment of optimum path, the buffer availability of nodes is checked at each intermediate node. If it is greater than some specific threshold value than a second condition is checked which is number of packets [10]. That means number of packets are counted for each individual destination at that buffer space. If it is greater than some threshold than alternate path is selected for routing otherwise packets are sent through the original path. Alternate path is same selected with the same procedure as that of original path. With this algorithm congestion problem is avoided and delay problem is handled. This increases the performance of network by increasing the throughput.

V. CONCLUSION

Routing in the WMN is the main concern which is severely affected by the congestion in the network. We hereby found that there is no single algorithm which prevents the congestion completely. Since the nodes in the network have limited bandwidth, queue space and power. So it is very necessary to find an algorithm which controls the congestion completely and enhance the system performance and quality of service. Since performance of the network depends upon the throughput, end to end delay and packet loss ratio. So, in future these algorithms can be modified to improve the system performance by using some buffer management techniques and monitoring end to end transmission in the network.

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