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Load Balancing Technique to Improve Video Traffic in Wireless Networks

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Abstract - This paper presents a load balancing technique to deliver the video data over the wireless networks. Wireless network are dynamic in nature .Due to this uneven distribution some node carry more traffic than the other and cause congestion. This congestion will drop the packet and reduces the overall network quality. It affects badly on the transmission of the data and cannot transmit the data efficiently. This reduce the quality of service .To overcome this problem the congested node are identified and data are rerouted to a newly selected path. By retransmission the packet drop can be minimized and improve the network quality.

Keywords – *Wireless Mesh Network, Traffic, Video, Load Balancing, Routing, Protocol*, QOS.

1. Introduction

Wireless mesh network is a communication network made up of radio nodes. Each node communicates directly or indirectly with one or more peer nodes. It consists of mesh client, router and gateway. It increases the coverage area and does not require any centralized access point for communication. A dhoc network is the subset of wireless mesh network. It is suitable for both short and long term applications.

They operate in the license-free spectrum which reduces the deployment costs compared to the other technologies. It forwards the traffic in multi hop manner. WMNs carry a variety of applications including multimedia applications such as voice, video and data .Recently end users required a good quality services. In order to deal with this rapid growth in demand for high quality content, new challenges to wireless mesh networks arise, especially in the area of QOS provisioning. Enabling QOS for a large number of applications is vital for the success of the future generation wireless networks. The QOS problem becomes more stringent in the multi-hop scenarios due to the increased number of retransmissions caused by interferences, collisions, congestion and dynamic nature [12].

Video delivering is very sensitive to delay variations. Another important factor which affects video delivery to end-users is packet loss which must be kept at low levels. Any delay variation or loss rate over a specific threshold decreases the QOS level, and consequently the service quality. Providing good video QOS levels in a WMN is an even more challenging task. Solutions applicable in wired networks do not work well in WMNs because of interferences, limited bandwidth, node dynamicity, overloading of the network and reliability. Mesh nodes can congest and fail suddenly and hence new routes need to be discovered to carry the traffic.

To improve the network traffic a load balancing solution is used for delivering the data across the network. This system contributes a load balancing solution which identifies the congested the node and reroute the data .By this way the network capacity is improved through a balanced distribution of flows.

2. Related Work

The decision for establishing the route for communication is done by routing protocol. Over the last few years, numerous routing protocols and algorithm are proposed and their performance under various network environment and traffic conditions are studied and compared. The ultimate goal of the MANET community is to provide a set of standardized protocols that can be both robust and scalable to the network so that the

message can be delivered reliably and in a timely manner with less overhead and bandwidth consumption. The two main type of routing protocol are reactive and non reactive routing protocols.

Ad hoc On Demand Distance Vector (AODV) which is a reactive routing protocol for mobile ad hoc network. It establishes the path between the source and the destination only when the path is needed. It allow mobile node to obtain route very quickly for a new destination .AODV are dynamic, self starting, multi hop routing which reduce the routing over head and it respond to link breakage. It uses the sequence number to find out the latest path for communication. It causes a delay for connection setup and also consumes more bandwidth due to periodic beaconing [1].

Optimized Link Sate Routing Protocol (OLSR) is based on the link state algorithm and it is proactive (table driven) in nature. It floods the message over the network .For this it use the multipoint relay technique. It efficiently and economically floods the control message .It is suitable for large and dense network. First it reduces the size of the control packets and secondly it minimizes the flooding by using the multipoint relay by diffusing the message into the network. This relay is used for retransmit its broadcast messages. It is designed to working distributed manner and it does not depend upon the central entity. It performs hop by hop routing. It requires more processing power and requires more time to rediscover when the link is broken [2].

The Estimated Transmission Time (ETT) metric considers the link transmission rate and packet size. For evaluating the link quality, a two back-to-back probes are used, one small probe followed by a large one, are sent by each node. The receiving neighbor measures the inter-arrival time between the two packets and reports it back to the sender of the two probes. After a certain number of probes are received, the sender computes the capacity of the link by dividing the size of the larger probe by the smallest delay measured. The route with the lowest sum of ETT values of the links along the path is chosen for routing. One of its drawbacks is that it does not consider link load, thus it cannot avoid routing the traffic through heavily congested nodes [3].

Hybrid Wireless Mesh Protocol (HWMP) which is the default routing protocol for WLAN mesh network. It contains both reactive routing components as well as proactive routing components [4]. This protocol can improve by increasing the bandwidth utilization and avoiding the network congestions. The method is based on the evaluation of QOS parameters as end-to-end delay [6].

A new cross-layer method for the routing is used in Wireless Mesh Networks. The different routing metrics plays an important role in multi hop routing, transmission delay, traffic load and bandwidth .This new link-layer sensing technique enables the transmitter to acquire the current contention status with low overhead, and rate adaptation is considered for the route discovery. This proposed QOS-Aware HWMP has a better average end-to end delay guarantees and bandwidth guarantees [7].

3. Load Balancing Traffic Control Protocol

In wireless network the traffic is unbalanced. Some node carries more traffic than the other .It cause congestion and loss packets which affects badly on the transmission. It decreases the quality of service. There will be distortion in the video transmission and reliability decreases. To overcome this issue Load Balancing Traffic Control Protocol is used (LBTC). It gives maximum priority to voice and video data and lower priority to the other data. LBTC is based on the video queue and its cross layer architecture is illustrated on the figure 1[12].

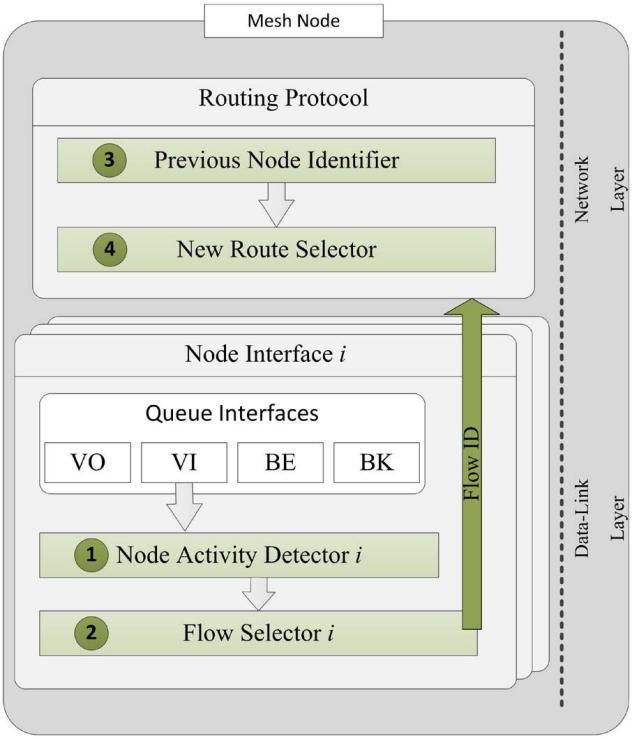

Fig. 1 Cross Layer Architecture of LBTC

It is based on the TCP/IP network protocol stack model. It comprises of components which resides at both network and data link layer. LBTC have four main stages which are described below [12].

(1) Monitoring:-The network is continuously monitored by the monitor node (MN).This monitored node will identify the congestion node. The status of the network are updating on each time .If any link are broken or added it is easily identified and updated on the routing table.

(2) Identification:-Due to uneven distribution of node some node are overloaded. Monitored node identifies the congested node and declares the current node as congested node. A threshold is maintained when the current node are more than the threshold value it became the congested node.

(3) New Path Selection:-When the current node became congested the traffic is blocked and data cannot be transmitted through that path. So a less congested path has to be selected for further transmission. New path is selected from the previous node. The previous node has the information about the nodes in the network. The utility function is calculated for each node .Utility function has two terms traffic terms and the distance term. Calculation is as follows. The α is the weighting factor of each node.

$$UF= \alpha T+1- \alpha.D \qquad (1)$$

Where, T= Number of packets stored in the video queue/Maximum number of packets can be stored on the queue.

D= Number of hops to the destination /Maximum number of hops that video are not degraded

(4) Rerouting: - By calculating the utility function the less congested node are determined. The node which offers best utility function is selected as the rerouted node. Through this node the data are rerouted. So the network becomes balanced and the data which are blocked can be retransmitted through this newly selected node.

When the traffic is high we select a new path and balanced network can be maintained throughout the transmission without any delay or degradation of the data. The network resources can be use sufficiently and reliability of the network are increased. The load balancing traffic protocol reduces the packet loss and improves the user perceived quality.

4. Simulation Results

Load Balancing Traffic Control Protocol is simulated by using the NS2 stimulator. Network Simulation is a widely used technique to develop network protocols, for testing in various network topologies and applications [5].

Performance of LBTC is evaluated by comparing with the OLSR protocol. OLSR is an optimization over a pure link state protocol as it compacts the size of information sent in the messages and it also reduces the number of retransmission. For this purpose it uses multipoint relaying technique to efficiently and economically flooding its control messages. But whenever a link is broken or added it will not repair or maintain the path. So the data across that path cannot be transmitted and increases the delay and packet loss ratio. This reduces the network quality and degrades the QOS [2]. Simulation metrics like end to end delay, PLR and PSNR are measured for OLSR and LBTC and their performance are evaluated.

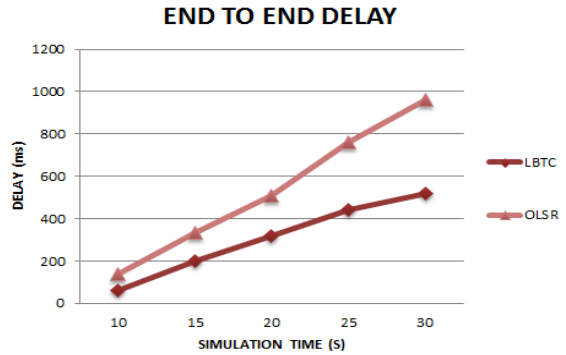

Fig. 2 Delay vs Simulation Time.

Figure 2 represents the delay vs. simulation time. End to end delay is the time taken by a packet to route through the network from a source to its destination. Here the OLSR have more delay than the LBTC .When delay decreases the network quality also increases.

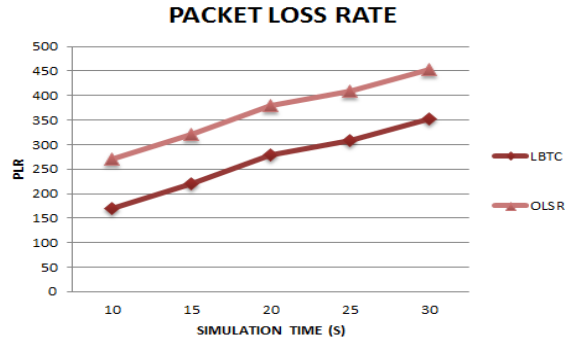

Fig. 3 PLR vs. Simulation Time.

Packet loss ratio is the number of packets that never reached the destination to the number of packets originated by the source. Due to delay and heavy traffic many packets are dropped. OLSR have high delay and high packet loss as compared with LBTC protocol.

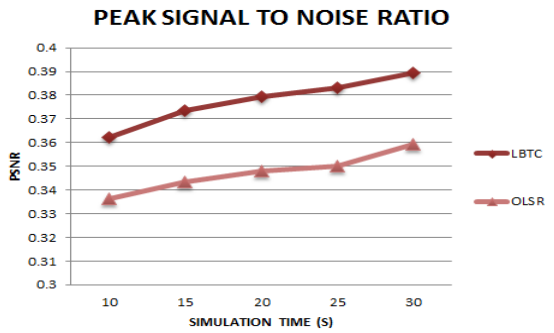

Fig. 4 PSNR vs.Simulation Time

PSNR is the ratio between the maximum possible values of a signal to the distorting noise that affects the quality. For a good quality network PSNR should be high value. LBTC have more PSNR value than the OLSR.

Table 1: Comparative Analysis between LBTC and OLSR

Metrics	***LBTC***	***OLSR***
Delay (ms)	31	136
PLR (%)	8	95
PSNR (db)	.45	.23

Table represents the comparative analysis between the LBTC and OLSR.OLSR has major drawback like whenever a link is broken or added it would not repair or maintain the network .So the packet drop will be more and overall network degrades. For evaluation purpose a wireless network of 40 nodes are created and measured the metrics parameters. In that evaluation we found that transmission LBTC require only 31 ms but OLSR require 137 ms .Only 8 packets are dropped in LBTC but 95 packets are losses for OLSR .For a good network PSNR should be more .So creating a network using LBTC protocol gives a better QoS for the users and increase the perceived quality in video transmission.

5. Conclusions

This paper addresses the issues of the unbalanced traffic condition in the wireless networks. This unbalanced condition leads to the poor utilization of networks resources by overloading some mesh nodes. Due to this congestion packet are dropped and data cannot be delivered efficiently. This heavy packet loss lowers the user perceived quality and reduces the overall QoS. Using LBTC protocol we can overcome the issues like congestion and packet loss by identifying the congested node and rerouting the data to a newly selected node which offer less congestion. It improves the QOS of the network and balances the network traffic.

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