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Distributed Packet Scheduling Algorithm for CLC Routing Protocol in MANET

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Abstract: Mobile Ad hoc networks are self organized and infrastructure less networks. It is becoming popular in recent years for multimedia data transmission. Even though, it is difficult to prove QoS parameters like throughput, end-to-end delay, efficient scheduling and neighbouring selection in MANET due to dynamic nature. This paper proposed Distributed Packet Scheduling Algorithm which meets QoS requirements especially in multimedia data transfer in newly implemented Cross Layer with Clump routing protocol. Simulation results are shows the improvement of the performance in Distributed Packet Scheduling compare with line scheduling and round robin scheduling methods.

Keywords: Packet Scheduling, QoS, throughput, Cross Layer MANET.

1. INTRODUCTION

Mobile Ad hoc network (MANET) is a collection of mobile nodes which does not required any infrastructure. In MANET, routing and resources management to be done in distributed manner therefore all nodes coordinate to enable communication among them. Each device free to move independently in any direction, therefore change its link to other device frequently.

An important research issues in mobile ad hoc networks is guarantee in quality of service in multimedia data transfer. Researchers always concentrate in designing routing algorithm [2], power conservative based on transmission power control [1], congestion control [3] identifying alternate wireless channel. But it is important that allocation of network resources in wireless ad hoc networks. Various scheduling algorithms have been proposed for providing to improve throughput, ratio of packet delivery and reduce losses of packets. But all these scheduling algorithms are not suitable for wireless ad hoc networks. Also most of the literatures focus on First Come First Serve (FCFS) queuing system [3] and it is inefficient in multimedia data transfer.

2. RELATED WORK

There is a lot of literature on scheduling algorithms for MANETs. The packet scheduling algorithm in MAC layer and routing algorithm [4] in network layer are tightly attached based on urgency metrics [5] to prove QOS in delay sensitive data over MANETs. The authors of [6] analyzed performance metrics the maximum sum rate for different kinds of linear receivers. The authors of [7] proposed reservation based routing protocols for Mobile ad hoc networks. Generally, reservation based routing protocols are create route based on nodes and links processing the resources required to fulfil QoS requirements. These protocols can increase QoS of the Mobile ad hoc networks in some extend, but these protocol suffer from problems in race conditions and invalid for reservation [8]. Fuzzy logic based packet scheduling system [9] has data rate, signal–to–Noice ratio and queue size as input and measuring various performance metrics compare with previous fuzzy scheduler. Various fairness models were analyzed and FSM Finite State Model [10] was proposed for Queue and transmission control mechanism and measuring throughput and fairness based on mobility for different flows. The authors of [11] compared Round Robin scheme with their proposed scheme called packet reserve function which is able to reduce the packet loss during transmission. Through this proposed scheme authors fulfil their objectives which is enhance the network performance in terms of fairness index and average end – to – end delay. The authors of [12] analyzed the following five kinds of scheduling algorithm for real time application for the users of mobile ad hoc networks. First in First Out Scheduling Algorithm, Priority Queue Algorithm, Weighted Fair Queuing Algorithm, Class Based Weighted Fair Queuing Algorithm and Low Latency Queuing (LLQ) Algorithm. Finally concludes that LLQ (low Latency Queuing) Scheduling Algorithm improves overall network performance. Authors also shows that the voice traffic transmitted with minimum delay and maximum throughput by LLQ compare with other scheduling algorithms.

3. CLC ROUTING PROTOCOL

The main objective of this routing protocol is multimedia packet and data packet transmission within QoS requirements. The entire process of CLC routing protocol will be divided into three phase.

1. Server Phase
2. Clump Node Phase
3. Resident Node Phase

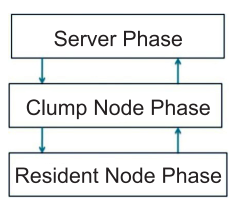

Figure 1: Three Layers of CLC Routing Protocol

3.1. Resident Node Phase

Each Resident node is having different performance metrics like signal strength, queue delay, scheduling feasibility in case of support for multimedia packet delivery. Each resident node maintain separate resident list which contains selected list of resident nodes from resident node selection algorithm.

3.2. Clump Node Phase

In this network, some nodes are working as data transfer node between server and resident node and vice versa. Those nodes are clump nodes. Minimize long route transmission and high delay will be proved by clump nodes. Clump leader node will be selected based on the performance of each clump node. The performances are high bandwidth, long energy, node can hold huge volume of data. Clump nodes are divided into group. Each group leads by a Clump Leader. In each group, clump leader and its members are having identification number. It is called Clump ID. Clump Leader transfer multimedia data packets and group member will transfer data packet.

3.3. Server

Server is a node which contains multimedia resources. It is well known to all cluster nodes and resident nodes and provides stream of multimedia data services to all other nodes. Whenever resident node request for services, server will send through clump node for data packet or clump leader for multimedia packets.

Each clump node connects with server for service providing to resident node within its clump group signal range. When node N_p in the clump group can provide streaming of multimedia service to node N_q, then node N_q disconnect from server and gathering resources from node N_p in the clump group. If node N_q require other than multimedia resource then it remains connects with server directly and act as a service provider for other clump node.

In case node N_q receive multimedia services from other node N_p in the same clump group. And node N_q keeps on coming out from the clump group range which leads to decrease its efficiency of delivering resources. Now node N_q disconnect from the clump group and connect to server.

If node N_q, detects that it decreases its transmission efficiency for receiving resources from the other node in the same clump, then node N_q re-search another clump member from the same group for service.

4. LINE SCHEDULING

In this scheduling, maximum weighted node will schedule first and then next maximum weighted node will schedule [13]. Lower weighted nodes may wait longer time to be schedule. This algorithm will schedule based on scanning of entire network using lines. This algorithm applies Bgreedy algorithm to the path for achieving optimal schedule. The algorithm is given below.

For each time slot ts

$S \leftarrow \phi$

$r \leftarrow$ no. of resident node in routing tree

//there is a unique path to clump node for each resident node

$\beta \leftarrow$ ts modulo r

Add all schedulable nodes in β-th path to S according to BGreedy algorithm

Apply Max Weight algorithm to add the remaining unscheduled nodes to S

Transmit packets from all nodes in S

end for

5. ROUND ROBIN SCHEDULING

The Round Robin Scheduling algorithm applies critical mechanism in resources allocation in Mobile Ad hoc Networks. This algorithm is simpler than other basic schedule algorithm. Per-flow buffers maintaining process is the core function of this scheduling algorithm [10]. Each clump node offers its packet transmission slots to its resident node by polling them in round robin order. Each clump node maintains two different queues to achieve bandwidth utilization by sending all packets at the head of Round Robin Queue continuously without delay due to back-off algorithm to prove Quality of Service. One of the queues is an origin queue for packet originated from the same clump node, which means the clump node directly connected to the server and packets received from the server directly. And the other queue is forwarding queue for packets sent from other clump nodes.

6. DISTRIBUTED PACKET SCHEDULING ALGORITHM

Using IEEE 802.11 protocol, the CLC distributed packet Scheduling algorithm is designed based on clump node's channel utility and workload. Since all clump nodes produce delay for packet forwarding. Therefore, we analysis channel utility of each clump node in a network with IEEE 802.11 in order to check the assumption holds true in practice.

This distributed Packet Scheduling Algorithm is proposed for routing the packets with reduces the transmission time. It assigns beforehand generated packets to clump node with high queue delays and assign more recently generated packets to clump node with lower queue delay. Hence the transmission delay of a packet stream is reduced.

Algorithm:

1. Time (T) is to be initialized for packet generation
2. Transmission Delay for QoS requirements (TQ) to be initialized
3. Bandwidth of Source node to be identified (B_s)
4. Bandwidth of clump node to be identified (B_c)
5. Based on step (3) and (4) Transmission delay (T_{d1}) between source and clump node to be identified
6. Transmission delay (T_{d2}) between clump node and Resident node to be identified
7. Calculate **Trans Delay** based on different between [$T_{d1} - T_{d2}$]
8. Calculate Packet queuing time for each node ($T_p(i)$)
9. Calculate overall packet Queuing time (T_p)
10. Call Queue delay requirements function

Function Queue Delay Requirements Function

It required following parameters:

(a) Overall Packet queuing time (T_p)

(b) Packet Queuing time for each clump node ($T_p(i)$)

(c) Transmission Delay QoS requirements (TQ)

(d) Transmission Delay between source and Clump node (T_{d1})

(e) Transmission Delay between Clump and Resident Node (T_{d2})

(f) Minus transmission delay between source node and clump node minus transmission delay between clump node and destination node

The following information sent out from the clump node.

1. Transmission delay and arrival interval of a packet with the priority
2. No. of packet arriving during the packet's queue time

After receiving this information from clump node, along with these information the source node includes the scheduling information of the flows in their queues, and calculate the packet queuing time of each clump node and choose selective clump node that satisfy queue delay requirement.

After selecting selective clump node by server, the earlier generated packets are transmitted to clump node with such a longer queue delay but within deadline. The transmission time of complete traffic flow possibly decreased by make use of queuing of previously generated packets and generating new packets eventually.

7. SIMULATION AND RESULTS

The Simulation has done by Network Simulator 2. The Generation rate of the CBR traffic is 100 kb/s. We randomly selected a source node and send a packet to destination node periodically. The warm up time was set as 50 s and simulation time was set to 200 s per round. This section demonstrates various properties of Distributed Scheduling and Line Scheduling and Round Robin scheduling through simulation results. Round Robin is a resource reservation based protocol for providing quality of service in MANET. Round Robin is extended from traditional scheduling method by inserting information about maximum delay with available bandwidth in each node in the network.

7.1. Performance in Packet Delivery Ratio

In Figure 2 shows that resulted packet delivery ratio with different packet size. 78% of packets are delivered with packet size of 500 when we apply DSA (Distributed Scheduling Algorithm) in CLC. In case of LSA (Line Scheduling Algorithm) in CLC only 58% of packets are delivered. When No. of packets were increased DSA in CLC slightly decreases their delivery ratio. When we apply LSA still it reduced its successful ratio.

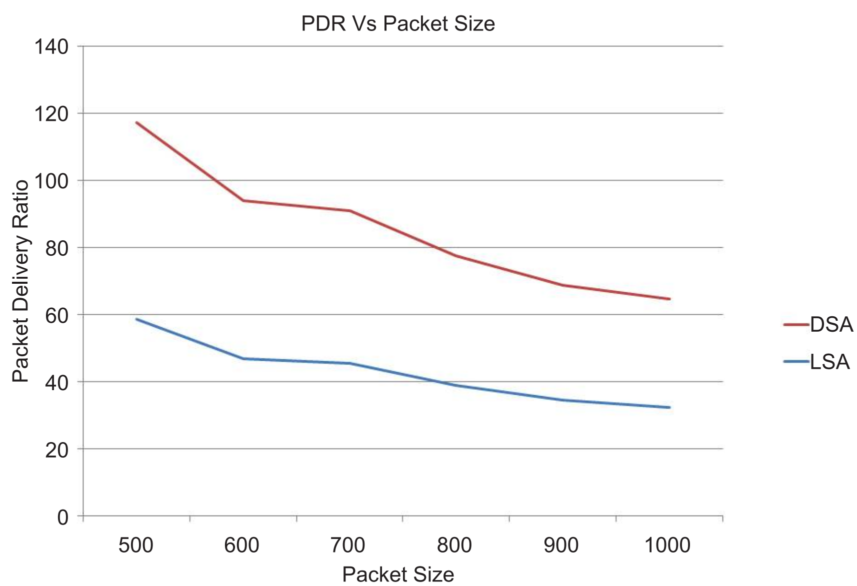

Figure 2: Performance in Packet Delivery Ratio

7.2. Performance in Throughput

In the simulation, variation shown on mobility speed from 0 m/s to 40 m/s with 10 m/s increment in each variation. The Figure 3 shows that throughput in DSA (Distributed Scheduling Algorithm) and RR (Round Robin) in CLC versus mobility speed. As mobility of a node increases then throughput of DSA were slightly decreases but RR decreases a lot after 15 m/s of mobile speed. This is because RR reserved resources in every link for traffic. In MANET, reserved links broken then source node is searching for new route. This results in delay and degrades the ability to meet QOS in throughput. Hence, RR is very difficult to meet QOS in MANET.

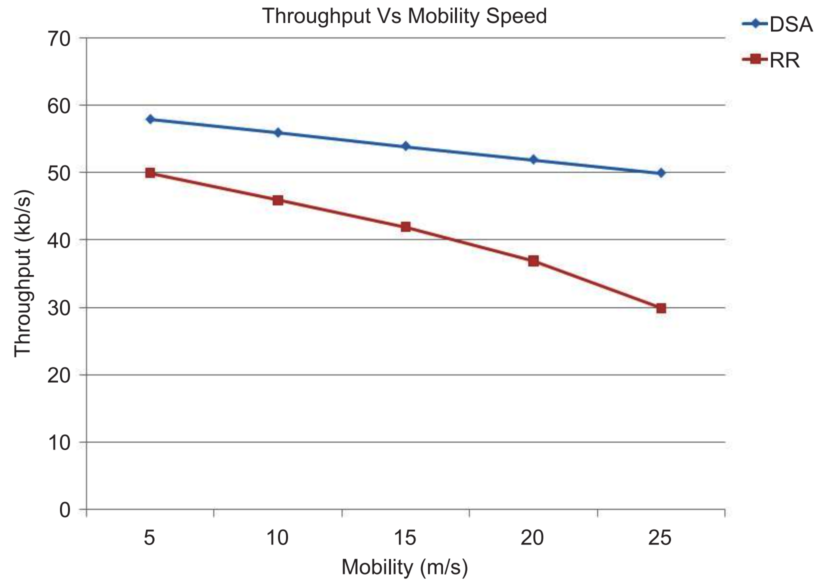

Figure 3: Performance in Throughput

Performance in End-to-End Delay

Figure 4 shows that average end to end delay versus packet size in DSA and RR in CLC protocol. End-to-End delay of RR Scheduling in CLC is between 2.9 to 6.2. When packet size increased as 1000 then delay is 6.21. But in DSA in CLC protocol delay is constant between 0 and 1. Due to its distributed packet scheduling scheme its delay will reduce enrich level. Because the transmission time of complete traffic flow possibly decreased by make use of queuing of previously generated packets and generating new packets eventually.

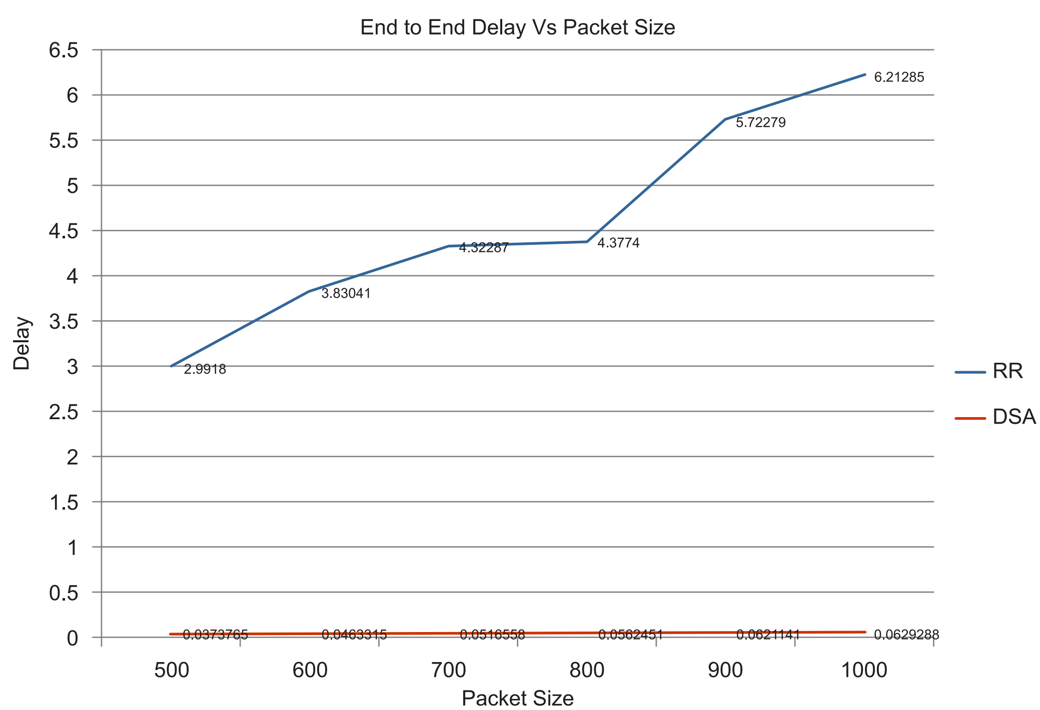

Figure 4: Performance in End-to-End Delay

8. CONCLUSION

This paper proposed CLC routing protocol with distributed packet scheduling for multimedia packet delivery in mobile ad hoc networks. It proves quality communication between resident node and resource centric node or server. Distributed packet scheduling performance was compare with various traditional packet scheduling. The results shows that how distributed packet scheduling in CLC routing protocol ensures efficient multimedia packet delivery between mobile nodes and achieves very lower average end to end delay and less packet traffic.

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