PERFORMANCE ANALYSIS OF PACKETS SCHEDULING WITH PREEMPTIVE

Norjanah Bt Kastaman
Bachelor of Electrical Engineering (Hons), Faculty of Electrical Engineering, Universiti Teknologi MARA

Abstract - **This paper presents a performance analysis of packets scheduling with preemptive in three commonly used scheduling mechanisms: WFQ, First in First Out and Priority Queuing.**

We implement a scheduler model and incorporate it into the IP layer output queues using OPNET 10.5 simulation tool. We measure the performance of the algorithms in terms of delay time, size of packet and overflow from different traffic flows during various time periods. We also simulate a network running several Internet applications: VoIP, FTP, video conferencing. Our simulation results indicate comparison of Priority Queuing, WFQ and First in First Out in internet application

Keywords: **OPNET, Priority Queuing (PQ) queue, Preemptive, VoIP, FTP, video conferencing**

1 INTRODUCTION

In today's high-speed packet networks that support various applications with different service requirements, congestion control is an important issue. One of the methods for preventing congestion is packet scheduling [12]. Packet scheduling in network can provide guaranteed performance in terms of delay, delay jitter, packet loss, overflow and throughput.

The rapid evolution of networks has brought up the issue of ever increasing demand for performance analysis and simultaneous support for different types of services in the same telecommunication network [5]. Thus, QoS has become a key factor in the deployment of today's networks and services. In general, QoS means providing consistent and predictable data or packet delivery service in order to satisfy different application requirements [12].

Packets scheduling such as First In First Out (FIFO), Weighted Fair Queuing (WFQ), Priority Queuing (PQ) and others also can be implement queuing techniques govern how the packet are buffered while waiting to be transmitted. This project was discussed about this three packets scheduling performance analysis using OPNET modeler.

Preemption or preemptive is the act of temporarily interrupting a task being carried out by a computer system, without requiring its cooperation, and with the intention of resuming the task at a later time. Such a change is known as a context switch. It is normally carried out by a privileged task or part of the system known as a preemptive scheduler, which has the power to pre-empt, or interrupt, and later resume, other tasks in the system.

2 PACKET SCHEDULING MECHANISM

2.1 First In First Out (FIFO)

This algorithm is uses one common buffer space in which packets are stored in case of output link congestion. The only configurable parameter for this scheme is the Maximum Queue Size (packets). When this limit is exceeded, the packets will be dropped from the buffer [2].

2.2 Priority Queuing (PQ)

A simple way of offering `different services to different classes of packets is Priority Queuing. Its operation involves classifying each incoming packet into different priorities and placing them into separate queues accordingly. The packets that have the highest priority are transmitted on the output port before the packets with lower priority [3].

2.3 Weighted Fair Queuing (WFQ)

Weighted Fair Queuing (WFQ) is a variation of processor sharing in that it supports flows with different bandwidth requirements. It does this by assigning each queue with different weights that corresponds to the proportion of the allocated output bandwidth. In WFQ, each incoming packet is time stamped with a finish time in addition to being placed into its corresponding flow queue. The selection of which packet to be serviced is now based on this time stamp on each packet. Further packets are serviced by examining their finish times. The ones with earlier finish times are transmitted before the ones with later finish times. It is possible for a later packet to have a finish time stamp that is smaller than an earlier packet [2].

3 METHODOLOGY

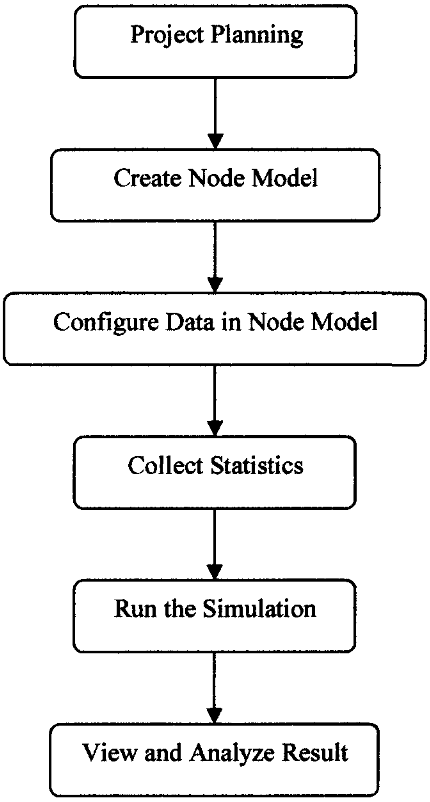

Figure 1

3.1 Project Planning

The packets scheduling are developed and conducted by using hierarchical software programming known as OPNET Modeler. This paper we choose voice over internet protocol (VoIP), file transfer protocol (FTP) and video conferencing as the experiment to know the performance through packets scheduling mechanism.

Today audio quality has been observed to become quite poor in a pure best-effort network, especially in congestion periods because it exceeds delay. It requires certain bounds on packet end-to-end delay and delay jitter to ensure a quality of the packets similar to the conventional network. So in order to make clear about this situation we choose VoIP, FTP and video conferencing as the experiment to compare it performance due to delay in packet size infinite buffer and queue overflow in FIFO, PQ and WFQ packets scheduling.

Beside that we simulate the comparison of packets scheduling due in application above in this experiment.

3.2 Choose the Statistics

To test the performance of the application defined in the network, statistics of the traffic must be collected. For this network model Global Statistic are choose to collected result.

3.3 Run the Simulation

After configure data in node model and statistic to collect have specified, it is ready to run the simulation. The simulation will show the graph of the node model which is already design in the beginning project.

3.4 View and Analyze Result

The final stage is to view and analyze the result from the simulation. The graph is evaluated in terms of its queue size (packet) and packet loss rate (overflow) and comparison of packets scheduling: FIFO, WFQ and PQ performance over VoIP, FTP and video conferencing.

3.5 Creation and Configuration Simulation

To built queue model in Figure 2 consists of the following objects: four processors, one queue and all this are connected with packet stream.

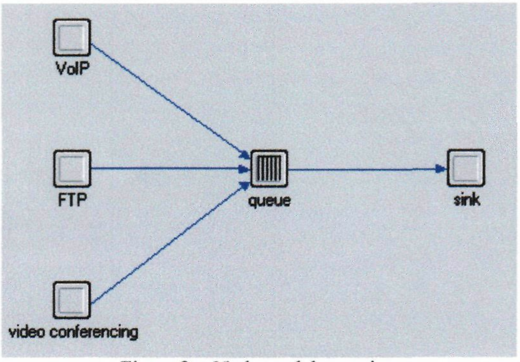

Figure 2: Node model overview

3.6 First in First out (FIFO)

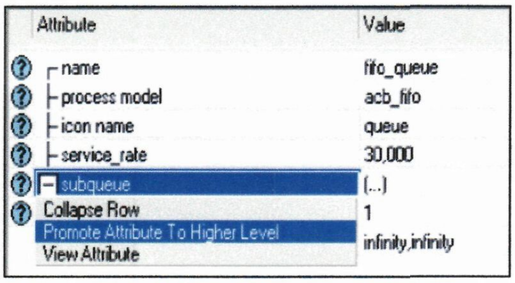

Figure 3: fifo_queue attributes

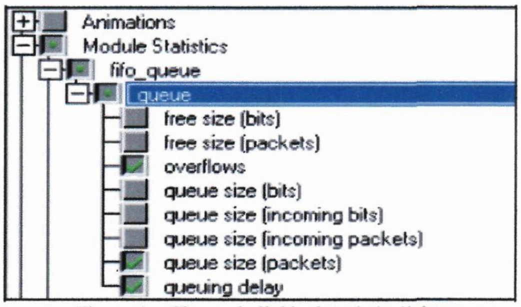

Figure 4: Choose individual statistic dialog

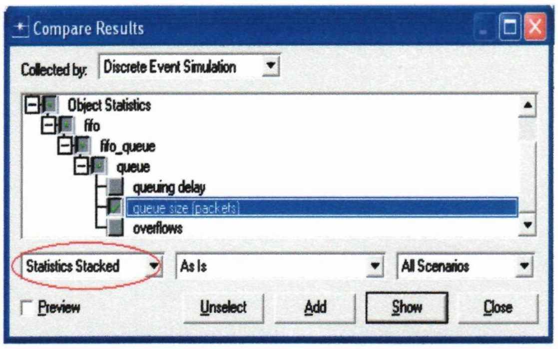

Figure 5: Compare results dialog

3.7 Priority Queuing (PQ)

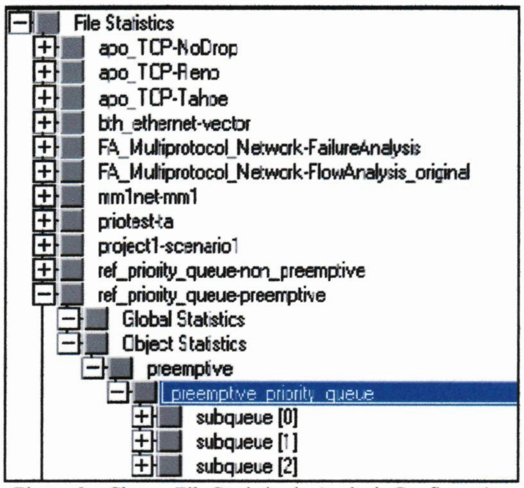

Figure 6: Choose File Statistics in Analysis Configuration tool

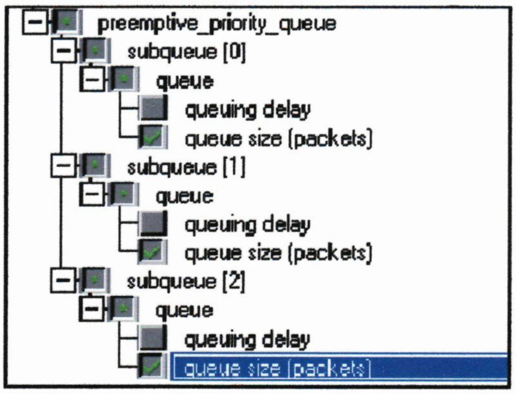

Figure 7: Chosen statistics for preemptive priority queue (queue size)

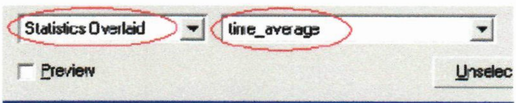

Figure 8: Graph layout setting queue size

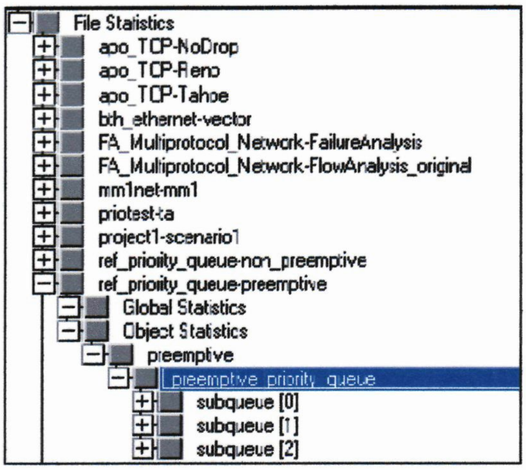

Figure 9: Choose File Statistics in Analysis Configuration tool

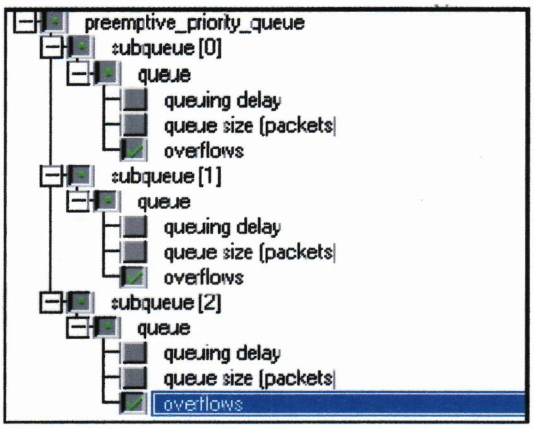

Figure 10: Selected statistics for preemptive priority queue (overflow)

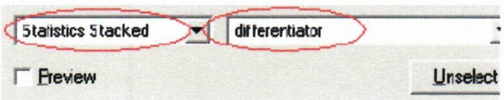

Figure11: Graph layout setting overflow

3.8 Weighted Priority Queuing (WFQ)

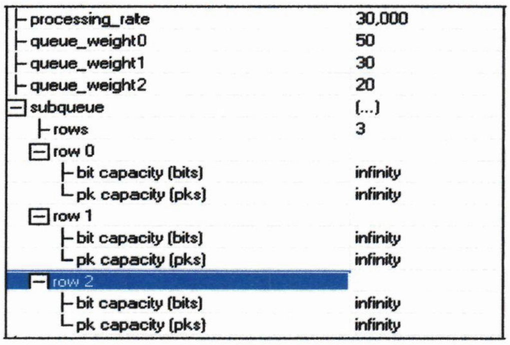

Figure12: WFQ processor setting

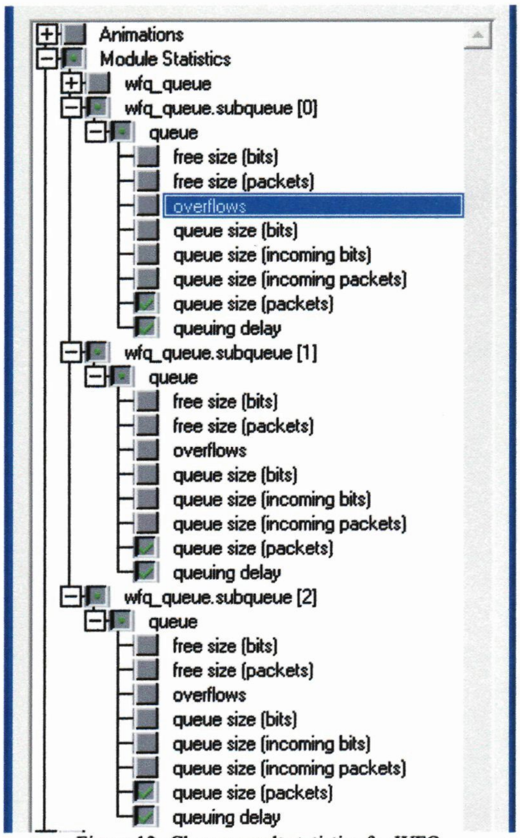

Figure 13: Choose result statistics for WFQ

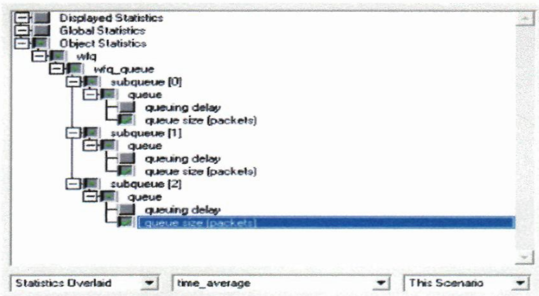

Figure 14: WFQ queue size graph results setting

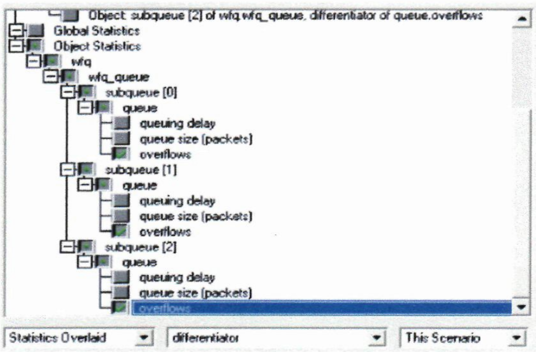

Figure15: WFQ packet loss graph results setting

4 RESULTS AND ANALYSIS

The results of the performance analysis of packets scheduling with preemptive over VoIP, Video conferencing and FTP performance are displayed below, which is indicate the performance characteristics in network model.

4.1 First in First Out (FIFO)

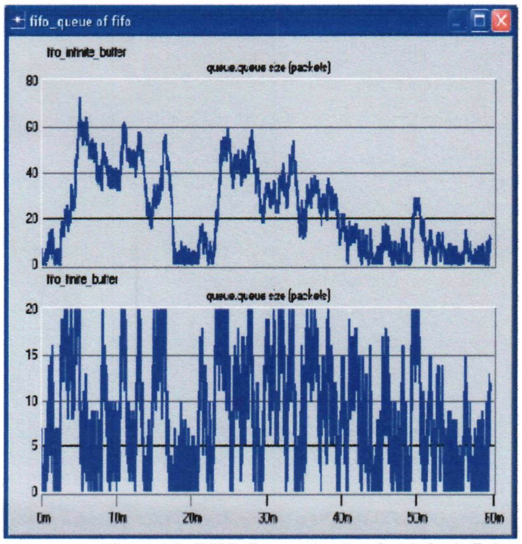

Figure 16: FIFO Queue size (packets) for infinite and finite buffers

From this simulation result we find that FIFO queue size infinite buffer is more stable than finite queue size. It also shows that infinite buffer was reach more than 60 packets compare with finite buffer is around 20 packets only.

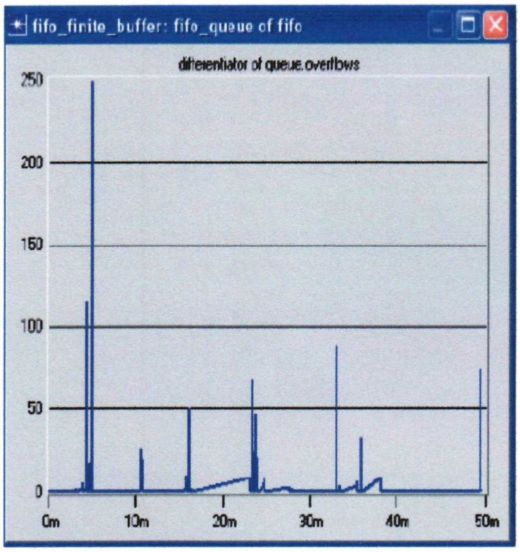

Figure 17: FIFO Queue overflow

Figure 17 show the packet overflow for finite buffer which is FIFO packet scheduling was reach until 250 packets before arrived in 10 minutes of the starting beginning operation in the network.

4.2 Priority Queuing (PQ)

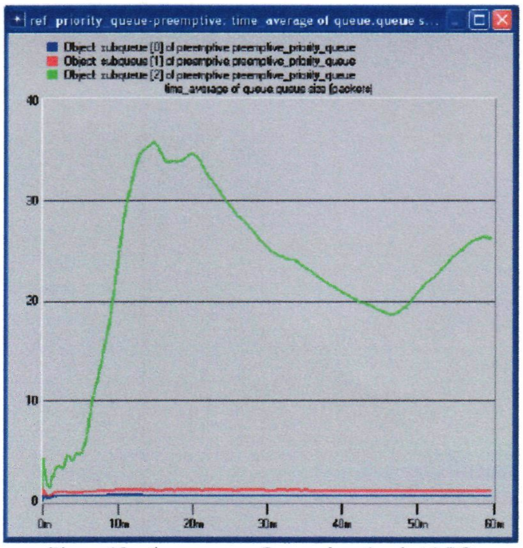

Figure 18: time average Queue sizes (packets) PQ

Referred to the Figure 18, it shown that the result of time average of queue size (packet) in three situations which is at object subqueue 0: video conferencing, object subqueue 1: FTP and object subqueue 2: VoIP.

Time average of queue size (packet) in subqueue 2 is highest compare with subqueue 0 and subqueue 1. From this graph, we can say that the time-average does not exceed the acceptable limit of 30 seconds, and that the queue is not monotonically increasing, as it go down around 47 minutes. Therefore, this is a stable system. Compare with subqueue 0 and subqueue 1 the time-average is steady state around 3 minutes.

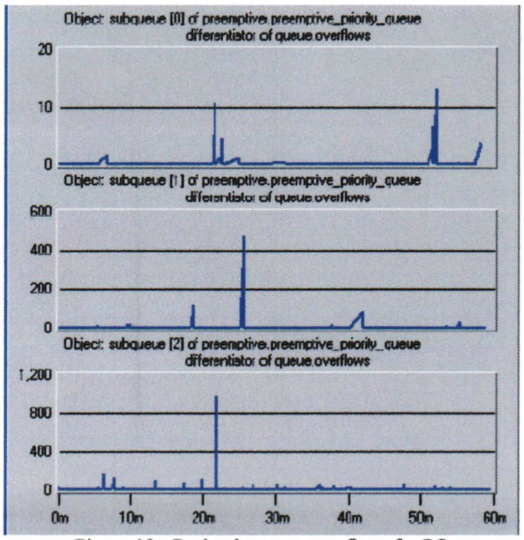

Figure 19: Packet loss rate overflow for PQ

Figure 19 show packet loss rate for preemptive priority queue. From this three application (VoIP, Video conferencing and FTP) we know that VoIP which is object subqueue 2 is highest overflow compare with video and RTP. It is about more than 800 seconds packet loss rate at around 23 minutes during conference call happened for example in VoIP.

Compare with Video conferencing and FTP the packet loss is more than 10 seconds and 400 seconds respectively.

4.3 Weighted Fair Queuing (WFQ)

Figure 20: time average WFQ queue size (packets)

Time average of queue size (packets) in subqueue 2 is highest compare with subqueue 0 and subqueue 1. From this graph, we can say that the time-average does not exceed the acceptable limit of 12 seconds, the queue is not monotonically increasing, as it goes down around 8 hours and below. At subqueue 0 which is video conferencing is in steady state after more than 3 hours.

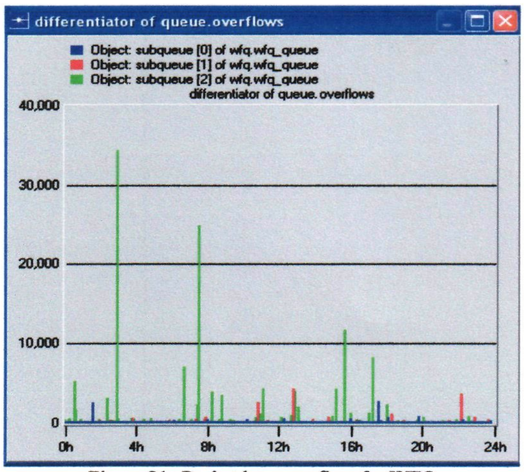

Figure 21: Packet loss overflow for WFQ

In this simulation of queue overflow we find that subqueue 2 (VoIP) is higher where more than 30000 packets in firs 4 hours compare subqueue 0 and subqueue 1 less than 10000 packets at time less than 24 hours.

5 FUTURE DEVELOPMENT

Development of queuing disciplines has been a great future for the internetworking but there still a lot of thing should be improved to make it work more fast and accurate. Since there are a lot of demands for the database transaction processing, and the number of services keeps increasing.

It also has being proved that is possible to implement and test a protocol using OPNET software, therefore is possible to create new protocols, improve existing protocols or just evaluate the behavior of them.

6 CONCLUSION

From this project we know that how this three source (VoIP, Video and FTP) very important in networking and telecommunications today and the performance in the network environment.. This project also provided an opportunity to experience the behavior of different networks and protocols but also a chance to learn the basic procedures of network simulation by using the OPNET Modeler simulation environment.

With this project also we could appreciate how the performance analysis of VoIP, FTP and Video Conferencing in terms of overflow, delay and queue size infinite and finite buffer as a result of taking away from the data line to control information

7 ACKNOWLEDGEMENT

I am proudly to convey my deepest appreciation and thanks to my project supervisor, Puan Darmawaty Bt Mohd Ali for her concern and support in guiding and giving motivation to complete this final year project.

I would like to express my foremost appreciation to my family also for their advices and supports in completing this project.

I also would like to express my special thanks to those individuals, who somehow have inspired and supported me and kept me constantly motivated toward the success of this project.

8 REFERENCES

[1] Victor A. Clincy and Ajay Sitaram, IP Queuing Analysis, Kennecsaw State University

[2] M. Markaki, M. P. Saltourros and I. S. Veneries, "Comparison of Packet Schedulers for Differentiated Service in the Internet", Proc. IFIP ATM & IP 2000, Ilkley, U.K, July 2000.

[3] Networkworld, http://www.networkworld.com/details/524.html?def

[4] http://www.opnet.com

[5] Modeling and Simulating Communication Networks, Irene Katzela, Published: Prentice Hall, Inc. 1999, ISBN: 0-13-915737-9

[8] Traffic Self-Similarity technical report, Adrian Popescu, BTH 2000

[9] http://en.wikipedia.org/wiki/Talk:Preemption_(computing)" Categories: Unassessed-Class Computing articles

[10] N. Alborz and Lj. Trajkovic, "Implementation of VirtualClock scheduling algorithm in OPNET," *OPNETWORK '01*, Washington, DC, Aug. 2001.

[11] M. Andrews, "Probabilistic end-to-end delay bounds for Earliest Deadline First scheduling," in *Proc. of INFOCOM '00*, Mar. 2000.

[12] N. Alborz, M. Keyvani, M. Nikolic, and Lj. Trajkovic, "Simulation of packet data networks using OPNET," *OPNETWORK '00*, Washington, DC, Aug. 2000.