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RESEARCH ARTICLE

MODELLING & SIMULATION OF QUEUING DISCIPLINES OVER THE N/W CARRIED APPLICATIONS (FTP, VIDEO AND VOIP) FOR TRAFFIC DROPPED & TIME DELAY

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***Abstract:** For modelling, simulation and analysing on these applications we used Optimised Network Engineering Tool environment. In the paper is investigated how the choice of the queuing discipline can affect the applications, utilization of the network resources and end to end delay. With the increasing number of internet users in recent times. Users are obsessed with multimedia applications available on internet, so put tremendous load on network. But network should maintain a good QoS (Quality of Service) to provide satisfactory results to the user. As congestion increases, it affects the performance of network and it tries creating imbalance. To avoid congestion many queuing disciplines are implemented, which assigns priorities to different applications executed by users to enhance the network performance.*

***Keywords:** Queuing Discipline, Router queue, first-in-first-out (FIFO) Queuing, Priority queuing (PQ) and Weighted-fair queuing (WFQ), Delay, QoS.*

I. INTRODUCTION

Some applications as FTP, HTTP and e-mail are not sensitive to delay of transmitted information, while other applications like voice and video are vulnerable to loss, delay and jitter of the information [1]. The QoS (Quality of Service) network devices must be able to differentiate among classes of arriving traffic and satisfy their individual requirements. This is the way to handle contention for network resources when the network is intended to service widely varying types of traffic and manages the available resources according to policies set out by the network administrator. Each router, as part of the resource allocation mechanisms, must implement some queuing discipline that governs how packets are buffered while wait to be transmitted. Various queuing disciplines can be used to control which packets get transmitted (bandwidth allocation) and which packets get dropped (buffer space). The queuing disciplines also affects to the packet latency by determining how long the packets wait to be transmitted. In the paper are discussed three queuing disciplines: first-in-first-out (FIFO) queuing, priority queuing (PQ) and weighted-fair queuing (WFQ) [2]. The modelling is experienced over the network that carries applications (FTP, Video and VoIP) and is investigated how the choice of the queuing discipline in the routers can affect the performance of these applications.

Now a day Internet only provides Best Effort Service. Traffic is processed as earliest as possible, but there is no assurance of timelines or real delivery. With the fast transformation of the Internet into a commercial infrastructure, demands for service quality have quickly developed. People of the current world are very much dependent on various network services like VOIP, Videoconferencing and File Transfer. Different types of Traffic Management systems are used in those services. Queuing is one of the very important mechanisms in traffic management system. Each router in the network must implement some queuing discipline that governs how packets are buffered while waiting to be transmitted. This paper gives a comparative analysis of three queuing systems FIFO, PQ and WFQ. The study has been carried out on some issues like: Traffic dropped Traffic Received and packet end to end delay. Various queuing disciplines can be used to control which packets get transmitted (bandwidth allocation) and which packets get dropped (buffer space). The queuing disciplines also affects to the packet latency by determining how long the packets wait to be transmitted. The modelling is experienced over the network that carries applications (FTP, Video and VoIP) and is investigated how the choice of the queuing discipline in the routers can affect the performance of these applications.

II. QUEUING DISCIPLINES

The FIFO queuing discipline is basic technique in which the first packet in the queue is the first packet that is processed. The size of buffer space (queue) at each router is finite. When queue becomes full, congestion occurs and incoming packets are dropped. The Priority queuing discipline uses multiple queues, but they are serviced with different level of priority. The queue with highest priority is serviced first. When congestion occurs, packets are dropped from lower-priority queues. The only problem with this method is that lower-priority queues may not get service at all if high-priority traffic is excessive. The packets are classified and placed into queues according to information in the packets.

The advantages of this discipline are:

- High priority traffic is always ensured quickest handling at the routers.
- This technique has high performance and utilization of available bandwidth.

The disadvantages are:

- Lower priority traffic has extensive packet drops and high queuing delays (starvation problem).
- The priority schemes may be abused by users or applications that mark packets with priorities that are not allowed.

The routers can be programmed to prioritize traffic for a particular port. In the IP Type of Service (ToS) field, each packet is to mark with priority level. The routers are implemented multiple FIFO queues, one for each priority level. This queuing discipline allows high-priority packets to cut to the front of the line. The Weighted-fair queuing discipline provides Quality of Service (QoS) by adding a weight to queues to give some queues higher priority. This shares the bandwidth proportional to the weights. All queues are serviced so that none are starved, but some queues are serviced more than others. Traffic may be prioritized according to the packet information in the source and destination IP address fields, port numbers and information in the ToS field. The Weighted-fair queuing discipline weights traffic so that low-bandwidth traffic gets a fair level of priority [3]. If high-priority queues are not in use, lower-priority traffic uses its queues. This prevents high-bandwidth traffic from grabbing an unfair share of resources. A unique feature of this queuing discipline is moving of the real-time interactive traffic to the front of queues and fairly shares the remaining bandwidth among other flows. ToS bits in the IP header is use to identify weight.

III. THE ROUTER QUEUES

Following figure helps in understanding how packet forwarding process takes place on the router. The router is represented by the big box. In our scenario it has two interfaces our scenario tells about the flows going from network connected to interface IF-0 (network A) to network connected to interface IF-1 (network B). After packets enter from interface IF-0 they are placed on queue 0.

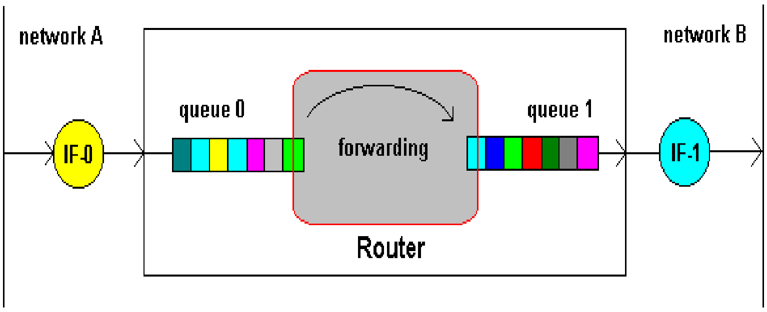

Figure 1 Packet Forwarding Process

Next, inside the router, the forwarding process takes place. Based on destination address on each packet header, some packets entering from interface IF-0 will be placed in the queue number 1 corresponding to the interface IF-1. Rate of forwarding is always greater than the rate at which the interface IF-0 can accept packets coming from network A. On the contrary, queue1 will be most of its time busy, depending mainly on the incoming rate of packets entering by the interface IF-0 and the outgoing rate of packets leaving to network B through the output interface IF-1.

IV. DIFFERENT FLAVOUR OF ROUTER QUEUES

Network experts have invented different kind or flavor of queues. This type, kind or flavors of queues are known with the name of "queuing discipline". The queue is an area of memory on router. For packets of size 1 KB there must be an area of 16 KB on memory to implement a sixteen packets FIFO queue. Queuing disciplines are algorithm written in some programming language, commonly the C Programming Language. The first, simplest and most used queuing discipline is the FIFO queuing discipline.

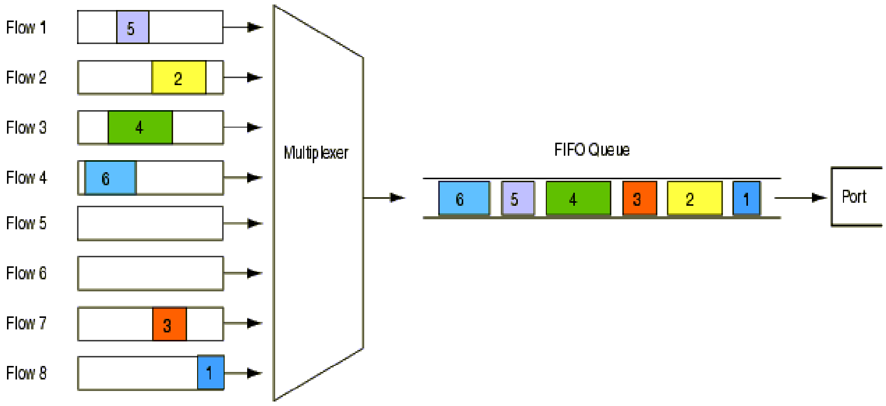

Figure 2 FIFO Queuing

FIFO Queuing Discipline: First-in, first-out (FIFO) queuing is the most basic queue scheduling discipline. In FIFO queuing, all packets are treated equally by placing them into a single queue, and then servicing them in the same order that they were placed into the queue. FIFO queuing is also referred to as First-come, first-served (FCFS) queuing. (See Figure 2.)

FIFO queuing offers the following benefits [4]:

- For software-based routers, FIFO queuing places an extremely low computational load on the system when compared with more elaborate queue scheduling disciplines.
- The behavior of a FIFO queue is very predictable—packets are not reordered and the maximum delay is determined by the maximum depth of the queue.
- As long as the queue depth remains short, FIFO queuing provides simple contention resolution for network resources without adding significantly to the queuing delay experienced at each hop.

FIFO queuing also poses the following limitations:

- A single FIFO queue does not allow routers to organize buffered packets, and then service one class of traffics differently from other classes of traffics.
- A single FIFO queue impacts all flows equally, because the mean queuing delay for all flows increases as congestion increases. As a result, FIFO queuing can result in increased delay, jitter, and loss for real-time applications traversing a FIFO queue.
- During periods of congestion, FIFO queuing benefits UDP flows over TCP flows. When experiencing packet loss due to congestion, TCP-based applications reduce their transmission rate, but UDP-based applications remain oblivious to packet loss and continue transmitting packets at their usual rate. Because TCP-based applications slow their transmission rate to adapt to changing network conditions, FIFO queuing can result in increased delay, jitter, and a reduction in the amount of output bandwidth consumed by TCP applications traversing the queue.
- A bursty flow can consume the entire buffer space of a FIFO queue, and that causes all other flows to be denied service until after the burst is serviced. This can result in increased delay, jitter, and loss for the other well-behaved TCP and UDP flows traversing the queue.

Priority Queuing: Priority queuing (PQ) is the basis for a class of queue scheduling algorithms that are designed to provide a relatively simple method of supporting differentiated service classes [5].

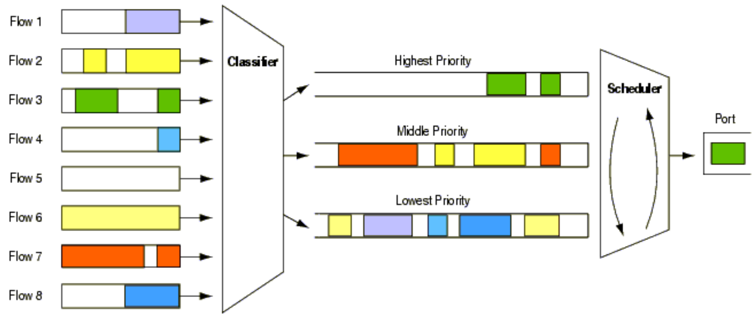

Figure 3 Priority Queue

In classic PQ, packets are first classified by the system and then placed into different priority queues. Packets are scheduled from the head of a given queue only if all queues of higher priority are empty. Within each of the priority queues, packets are scheduled in FIFO order.(See Figure 3)

PQ offers a couple of benefits:

- For software-based routers, PQ places a relatively low computational load on the system when compared with more elaborate queuing disciplines.
- PQ allows routers to organize buffered packets, and then service one class of traffic differently from other classes of traffic. For example, you can set priorities so that real-time applications, such as interactive voice and video, get priority over applications that do not operate in real time.

But PQ also results in several limitations:

- If the amount of high-priority traffic is not policed or conditioned at the edges of the network, lower-priority traffic may experience excessive delay as it waits for unbounded higher-priority traffic to be serviced.
- A misbehaving high-priority flow can add significantly to the amount of delay and jitter experienced by other high-priority flows sharing the same queue.
- PQ is not a solution to overcome the limitation of FIFO queuing where UDP flows are favoured over TCP flows during periods of congestion. If you attempt to use PQ to place TCP flows into a higher-priority queue than UDP flows, TCP window management and flow control mechanisms will attempt to consume all of the available bandwidth on the output port, thus starving your lower-priority UDP flows.

Weighted Fair Queuing: WFQ is like having several doors. When a packet arrives it is classified by the classifier and assigned to one of the doors. The door is the entry to a queue that is served together with some other in a weighted round-robin order. This way the service is 'fair' for every queue.

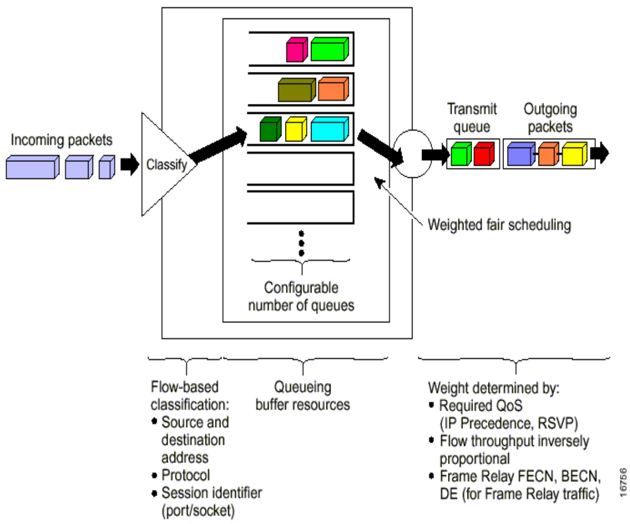

Figure 4 Weighted Fair Queuing

The key to classify a flow is a conversation, this means, a numeric representation based on information taken from the packet header (source address, source port, destination address, protocol, IP precedence, etc.) for classification. Because it is not practical to have one queue for each conversation, WFQ employs a hashing algorithm which divides the traffic over a limited number of queues to be selected by the user or fixed by default. This way increasing as large as possible the number of queues helps the fairness of the algorithm. In simple words, one can have several flows sharing the same queue; it can be seen in the figure 4 when packets of different colours share the same queue.

Weighted fair queuing has two primary benefits:

- WFQ provides protection to each service class by ensuring a minimum level of output port bandwidth independent of the behaviour of other service classes.
- When combined with traffic conditioning at the edges of a network, WFQ guarantees a weighted fair share of output port bandwidth to each service class with a bounded delay.

However, weighted fair queuing comes with several limitations:

- Highly aggregated service classes means that a misbehaving flow within the service class can impact the performance of other flows within the same service class.
- WFQ implements a complex algorithm that requires the maintenance of a significant amount of per-service class state and iterative scans of state on each packet arrival and departure.
- Finally, even though the guaranteed delay bounds supported by WFQ may be better than for other queue scheduling disciplines, the delay bounds can still be quite large.

Car queuing Discipline: CAR is a multifaceted feature that implement both classification service and policing through rate limiting. CAR also has marking capabilities offering us the possibility for building partial compliance Differentiated Service architecture. For doing all this it must implement these devices

- Classifier: an entity which selects packets based on the content of packet headers according to defined rules; a multi-field (MF) classifier selects packets based on the content of some arbitrary number of header fields; typically some combination of source address, destination address, DS field, protocol ID, source port and destination port.
- Meter: metering is the process of measuring the temporal properties (e.g., rate) of a traffic stream selected by a classifier. The instantaneous state of this process may be used to affect the operation of a marker, shaper, or dropper, and/or may be used for accounting and measurement purposes; a meter is a device that performs metering.
- Dropper: dropping is the process of discarding packets based on specified rules; a dropper is a device that performs dropping.
- Policer: policing is the process of discarding packets -by a dropper- within a traffic stream in accordance with the state of a corresponding meter enforcing a traffic profile; a policer is a device that performs policing.
- Marker: marking is the process of setting the DS code point in a packet based on defined rules; a marker is a device that performs marking.

V. RESULTS

In this paper three queuing disciplines are evaluated. The simulation model of first-in-first-out (FIFO) queuing, priority queuing (PQ) and weighted-fair queuing (WFQ) is shown in figure below.

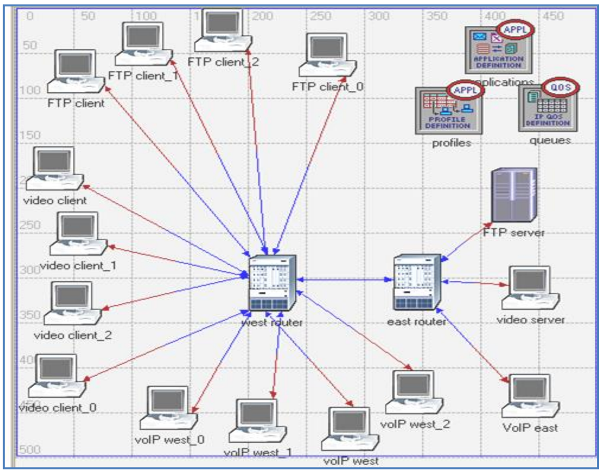

Figure 5 Simulation Model FIFO

The results of the affect of different queuing disciplines over FTP, Video and VoIP performance are displayed as graphs, which indicate the performance characteristics of queuing disciplines in the routers of network model.

On below figure is shown the dropped IP data packets for three queuing disciplines (FIFO queue, Priority queue and Weighted-fair queue) as a function of the time in seconds.

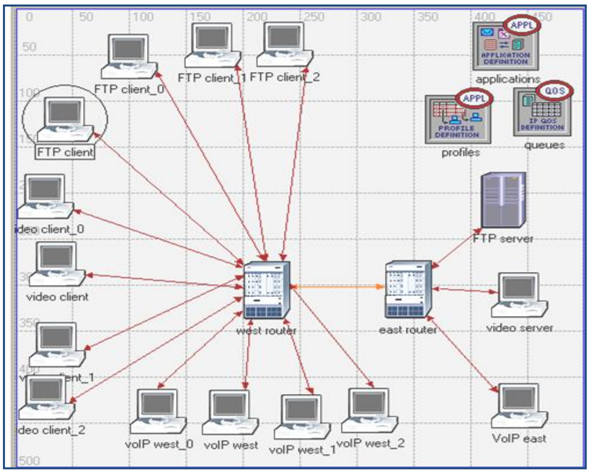

Figure 6 Simulation Model PQ

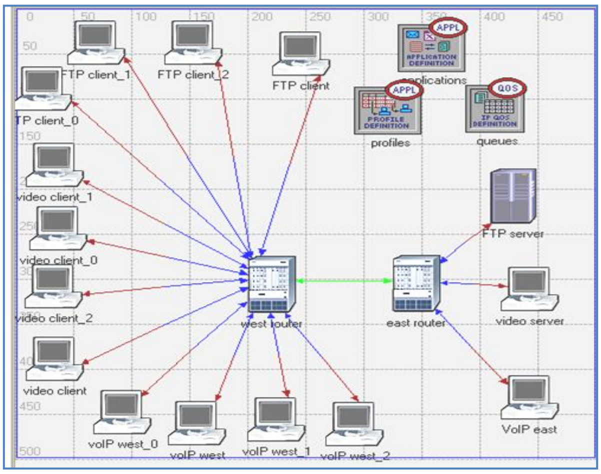

Figure 7 Simulation Model WFQ

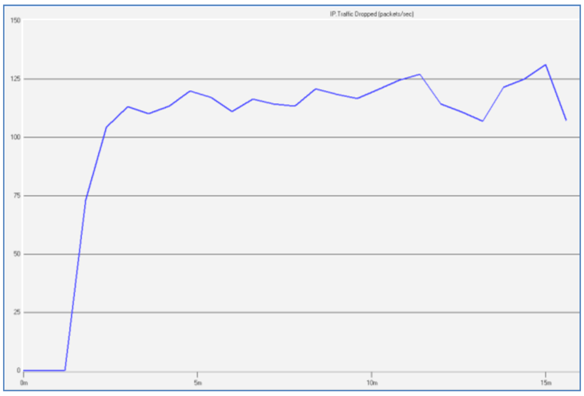

Figure 8 Traffic dropped FIFO

Fig. 11 shows the complete analysis of IP Traffic dropped (Packet/sec) for all three queuing disciplines i.e. first-in-first-out (FIFO) queuing, priority queuing (PQ) and weighted-fair queuing (WFQ)

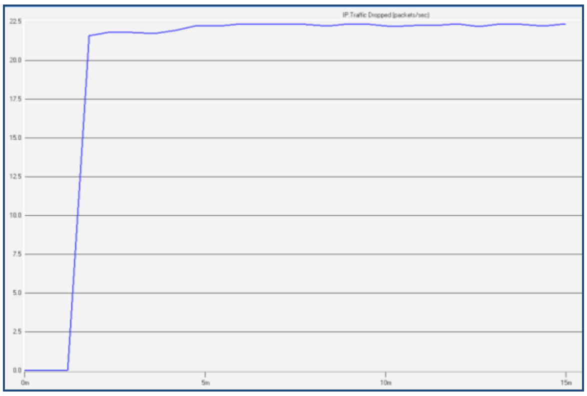

Figure 9 Traffic dropped PQ

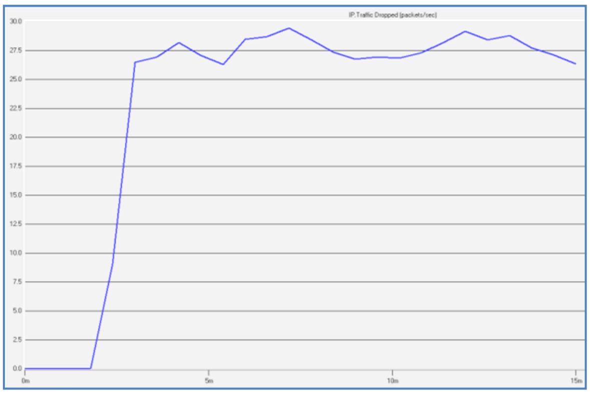

Figure 10 Traffic dropped WFQ

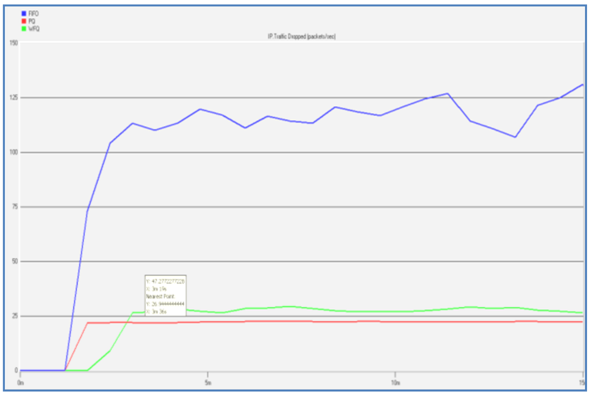

Figure 11 IP Traffic dropped (Packet/sec)

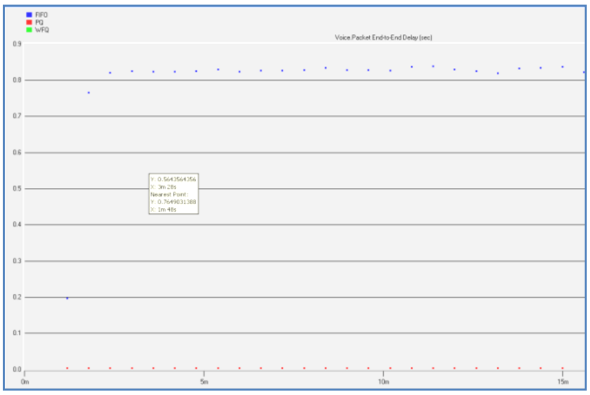

Figure 12 voice packet end to end delay(sec)

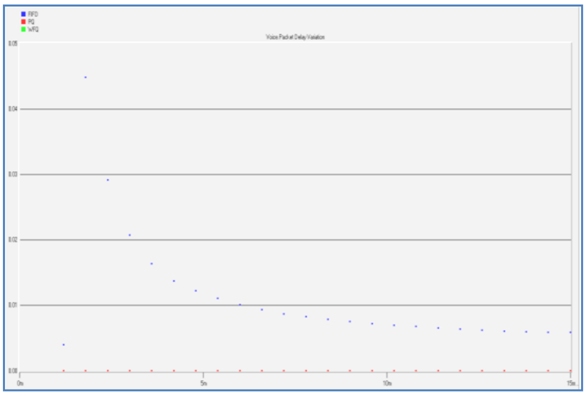

Figure 13 voice packet delay variation

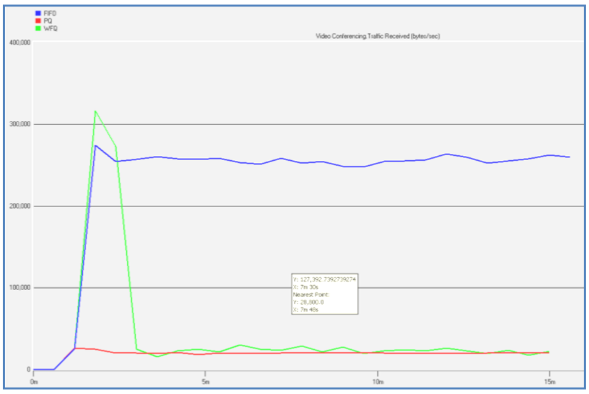

Figure 14 Video conferencing traffic received (bytes/sec)

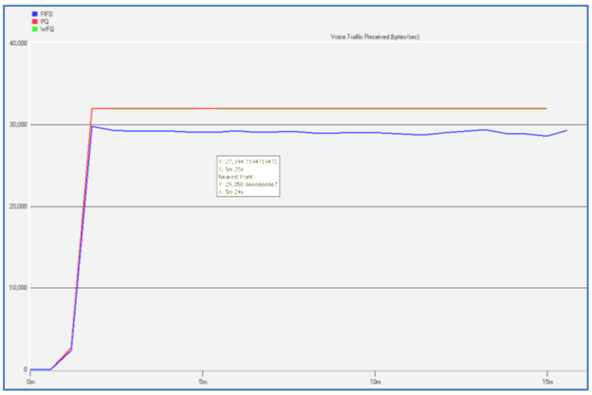

Figure 15 Voice Traffic receiver (bytes/sec)

On Fig. 12 shows the received traffic (bytes) for the three queue disciplines as a function of voice packet end to end delay(sec). Fig. 14 and Fig. 15 are show the received traffic (bytes) for the three queue disciplines as a function of the time (seconds) for video and voice applications.

The Priority and Weighted-fair queues are the most appropriate scheduling schemes for the handling of voice traffic.

CONCLUSION

Based on the simulation results obtained, the network performance of queuing technique was compared. The evaluation between different queuing for Qos, VoIP and video

Conference, it is concluded that the best technique in queuing is PQ due to the lower value in packet end to end delay and Packet delay variation. The Priority and Weighted-fair queues are the most appropriate scheduling schemes for the handling of voice traffic.

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