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Review on Optimization of Computer Networks Using QOS

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Abstract—Quality of Service (QoS) techniques are applied in IP networks to utilize available network resources in the most efficient manner to minimize delays and delay variations (jitters) in network traffic having different type of services. The services may include voice, video & database.The main aim of this research paper is to highlight QoS analysis in a wired IP network using different queuing disciplines such as FIFO, Priority Queuing & to implement these queuing disciplines & find out the results.

Keywords— Quality of Service, Queuing, Delay, Delay Variation, Jitter

I. INTRODUCTION

Wired networks are now dealing with high-bandwidth traffic & applications having strict requirements of successful packet delivery with minimal delay and delay variations. Major applications may include Voice over IP (VoIP) and Video Conferencing (VC) which are highly sensitive to loss, delay and jitter. When high-bandwidth and delay sensitive services are the part of network, some Quality of Service (QoS) mechanism is applied to guarantee successful packet delivery with reduced latency and jitter according to assigned priority of packets. [1]

Quality of service is the ability to provide different priority to different applications, users, or data flows to guarantee a certain level of performance to a data flow. For eg, a required bit rate, delay, jitter, packet dropping probability and/or bit error rate may be guaranteed.

A queuing discipline is implemented according to which packets are processed. Queuing schemes provide predictable network service by providing dedicated bandwidth, controlled jitter & latency, and improved packet loss characteristics. The basic idea is to pre-allocate resources (e.g., processor and buffer space) for sensitive data. Major queuing disciplines are First in First out (FIFO), Priority Queuing (PQ) and Weighted Fair Queuing (WFQ) [2].

In FIFO, a single queue is maintained for all traffic and first packet arriving at the router is processed first. In Priority Queuing, individual queues are maintained for each priority level and router processes the complete queue with the highest priority first. In WFQ, weights are assigned to each queue according to priority level. In this way, lower priority packets can also get their share in the link's bandwidth without having to undergo unacceptable delays in processing due to higher priority packets [1, 2]

II. RELATED STUDY

Muhammad Aamir, Mustafa Zaidi and Husnain Mansoor[1] discussed QoS analysis in a wired IP network with more realistic enterprise modeling and presents simulation results. Two major queuing disciplines are evaluated i.e. 'Priority Queuing' and 'Weighted Fair Queuing'. In the end, it is also analyzed how network's database service with applied Quality of Service may be affected in terms of throughput (average rate of data received) for internal network users when the server is also accessed by external user(s) through Virtual Private Network (VPN).

T. Velmurugan, Himanshu Chandra, and S. Balaji [2] discussed various queuing disciplines can be used to control which packets get transmitted (bandwidth allocation) and which packets get dropped (buffer space). The queuing discipline affects the latency experienced by a packet, by determining how much time a packet waits to be transmitted. Examples of the common queuing disciplines are first-in first-out (FIFO) queuing, priority queuing (PQ), and weighted-fair queuing (WFQ)

Mitko Gospodinov [3] discussed the affects of different queuing disciplines on packet delivery for three applications: FTP, Video & VoIP. For modelling, simulation and analysing on these applications is used OPNET (Optimised Network Engineering Tool) environment. In the paper it is investigated how the choice of the queuing discipline can affect the applications and utilization of the network resources in the routers.

Salil Bhalla, Kulwinder Singh Monga,Rahul Malhotra [4] discussed the affects of First in First Out (FIFO) & Priority Queuing (PQ) on packet delivery for applications such as Video and VoIP. For modelling, simulation and performance evaluation on these applications is using OPNET (Optimised Network Engineering Tool) environment. In this paper, it is investigated how the choice of the queuing discipline can affect the applications and utilization of the network resources in the routers.

F. Kamoun, L. Kleinrock [5] surveyed the nodal storage limitations leading to blocking and degradation of network performance in a store and forward computer network. The paper discussed about five sharing schemes for sharing a pool of buffers among a set of communication channels. The sharing schemes were examined, analyzed and displayed in a fashion that establishes the tradeoffs among blocking probability, utilization, throughput and delay.

The discussion about the quality of service (QoS) in providing internet protocol (IP) based service in wireless and wired networks have been carried by *Jukka Manner* et.al (2002). The study focused on the shortcomings of real time transport protocol (RTTP), insiginia and itsumo protocols. The study focused on the methodologies like strict flow shaping at the network edge, coupling of micro-mobility and quality of service (QoS) protocols, advanced reservations, pre handover negotiations and context transfer methodologies were adopted for improvement in quality of service (QoS).

F. Cali, M.conti, E. Gregori [6] discussed the efficiency related issues of the IEEE 802.11 standard for wireless LANs. The study derived an analytical formula for the protocol capacity and determined the theoretical upper bound of the institute of electrical and electronics engineering IEEE 802.11 protocol capacity. The paper also proposed a distributed algorithm that enables each station to tune its backoff algorithm at run-time, resulting in enhancement in the performance of the IEEE 802.11 protocol. The findings results were verified by simulation process.

C.S. Raghavendra, M. Gerla, A. Avizienis [7] adopted highly reliable and efficient double loop network architecture. The network for forward loop backward hop topology with a loop in the forward direction connecting all the neighboring nodes and a backward loop connecting nodes that are separated by a distance ($\sqrt{N}$) where N is the number of nodes in the network. The study shows that this topology is optimal among the class of double-loop networks in terms of diameter, processing overhead, delay, throughput & reliability.

S. Pierre, G. Legault [8] discussed hypercube structures for interconnection of microcomputers in parallel and distributed environments. The interconnection was based upon a mixed radix number system and the technique resulted in a variety of hypercube structures for a given number of processors N depending on the desired diameter of the network. A cost optimal realization was obtained through a process of discrete optimization. The study also compared the performance of the proposed hypercube structures with other existing hypercube structures such as Boolean n-cube and nearest neighbor mesh computers.

III. ANALYSIS AND COMPARISION OF ALGORITHMS EFFICIENCY

Case Study 1: In this scenario FIFO queuing is used at the IP layer. The network is composed of four pairs of video clients. Each pair uses a distinct TOS for data transfer. Again the link between the two routers is a "potential" bottleneck. FIFO queuing can be enabled on each interface. Queuing profile and queuing processing mechanism are set in attribute "QoS info". Queuing profile defines the number of queues and the classification scheme. Queuing profiles are defined in the QoS configuration object. This object is found in "utilities" palette.

Table 1. Attributes of the Case Study 1

Number of Queries	60 %
Transaction Inter arrival Time	10 sec
Transaction Size	32768 bytes
TOS	Best Effort
Receive Inter Arrival Time	360 secs
Inter Request Time	3600 secs
File Size	50000 bytes
Buffer Size	1 Mbyte
Queuing Scheme	FIFO
Queuing Profile	FIFO Profile

Case Study 2: In this queues are serviced using "Priority Queuing" mechanism. Priority queuing can be enabled on each interface in routers. Queuing profile and queuing processing mechanism are set.

Table 2. Attributes of the Case Study 2

Attribute	Value
Number of Queries	60 %
Transaction Inter arrival Time	10 sec
Transaction Size	32768 bytes
TOS	Best Effort
Receive Inter Arrival Time	360 secs
Inter Request Time	3600 secs
File Size	50000 bytes
Buffer Size	1 Mbyte
Queuing Scheme	Priority Queuing
Queuing Profile	TOS Based

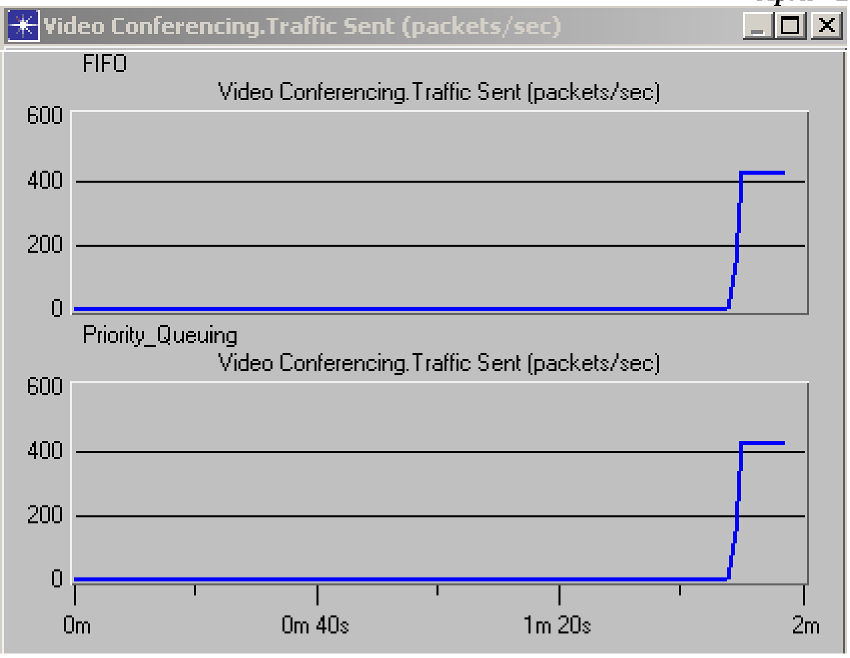

Figure 1. Traffic sent (packets /sec)

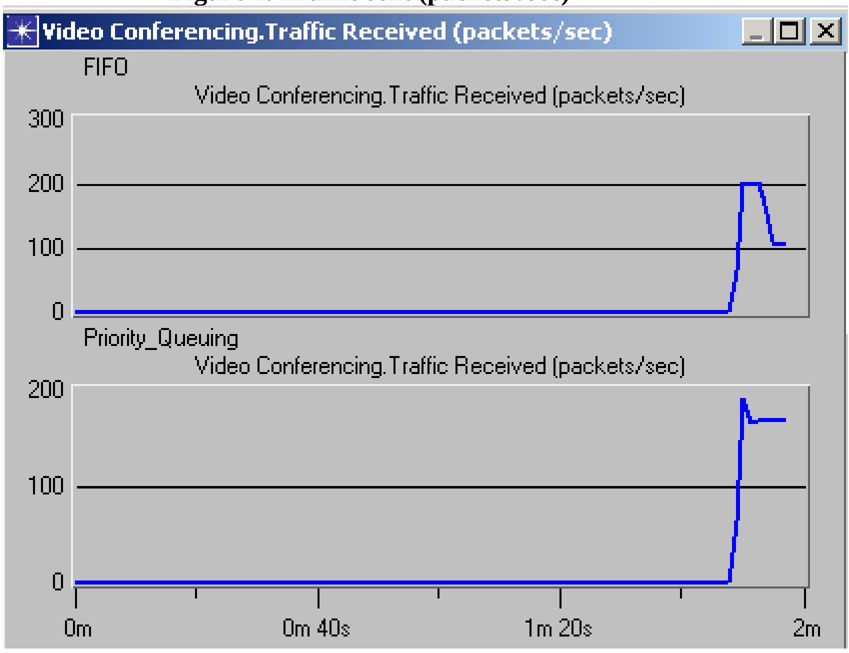

Figure 2. Traffic received (packets /sec)

IV. CONCLUSION

This paper analyzes and compares performance of networks using FIFO and Priority Queuing. As a result of this classification traffic with higher TOS gets better delay. These queuing disciplines will be further implemented by changing the attributes. The performance of Computer Networks is also evaluated using some other queuing discipline as Custom Queuing using OPNET.

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