Performance Analysis of Queuing Disciplines for Different Internet Service Protocols

Neha Ghaisas
Department of Computer Engineering,
Thakur College of Engineering and Technology,
Kandivali (East), Mumbai, India

R.R Sedamkar
Professor and Dean Academics,
Thakur College of Engineering and Technology,
Kandivali (East), Mumbai, India

Rashmi Thakur
Asst. Professor, Department of Computer Engineering,
Thakur College of Engineering and Technology,
Kandivali (East), Mumbai, India

ABSTRACT
In Internet traffic is processed as quickly as possible, but there is no guarantee of timelines or genuine delivery. Different internet services such as FTP, VoIP and Video uses various traffic management systems. Queuing is one of the very essential mechanisms in traffic management system. Therefore Queuing disciplines are implemented in routers to administer, run, arrange and to prioritize packets in the buffers prior to their transmission. This paper attempts to analyze three queuing systems which show how the choice of the queuing discipline in the routers can affect the performance of the applications and the utilization of the network resources. The study has been carried out using OPNET Modeler simulation tool based on performance metrics as Traffic dropped Traffic Received and packet end to end delay and the simulation results illustrates that WFQ technique is superior compare to other techniques.

Keywords
FTP, Video, VoIP, Queuing Discipline, OPNET Modeler, WFQ

1. INTRODUCTION
As part of the resource allotment mechanisms, each router required to execute various queuing techniques that manage how packets are buffered while waiting to be transmitted. A variety of queuing disciplines can be used to manage which packets get transmitted (bandwidth allocation) and which packets get dropped (buffer space). The queuing techniques also affect the latency experienced by a packet, by identifying how long a packet waits to be transmitted.

Different queuing techniques can be used to control which packets get transmitted and which packets which packets get dropped.

The queuing disciplines are:
1. First-in-first-out (FIFO) queuing.
2. Priority Queuing(PQ)
3. Weighted-Fair queuing.(WFQ)

The design of FIFO queuing is that the first packet that appears at a router is the first packet to be send out. Given that the quantity of buffer space at each router is restricted, if a packet appears and the queue (buffer space) is occupied, then the router rejects (drops) that packet. This is done without considering to which flow the packet to be fit in or how important the packet is.

PQ is a simple deviation of the basic FIFO queuing. The design is to spot each packet with a priority; the mark could be passed, for example, in the IP Type of Service (ToS) field. The routers then execute several FIFO queues, one for each priority class. Within each priority, packets are still supervised in a FIFO manner. This queuing technique permits high priority packets to slice to the front of the line.

The design of the fair queuing (FQ) discipline is to preserve a separate queue for each flow presently being handled by the router. The router then services these queues in a round robin manner. WFQ allows a weight to be allocated to each flow (queue). This weight powerfully controls the percentage of the link's bandwidth each flow will get. We might use ToS bits in the IP header to discover that weight.

2. LITERATURE SURVEY
Relative study of Queuing techniques and throughout simulation which is enhanced method of queuing is explained in [1]. Results illustrate that WFQ and PQ outperforms other techniques in terms of average traffic throughput and queuing delay. [2] Gives a relative study of three queuing systems FIFO, PQ and WFQ using performance metrics Traffic dropped Traffic Received and packet end to end delay and the simulation results observed that WFQ technique is better than the other techniques. [3] Discussed the influences of different queuing techniques on packet delivery for three applications: FTP, Video & VoIP. For modelling, simulation and analysing on these applications OPNET (Optimized Network Engineering Tool) environment is used. In the paper it is inspected how the choice of the queuing techniques can change the applications and consumption of the network resources in the routers. [4] Discussed the influences of First in First out (FIFO) & Priority Queuing (PQ) on packet delivery for applications such as Video and VoIP. Review of QoS study in a wired IP network using different queuing techniques such as FIFO, Priority Queuing is explained in [5]. The implication of different queuing algorithms within the router on VoIP QoS studied in [6] assessment was carried out between different queue algorithms like First in First out (FIFO), Priority queue (PQ) and Weight Fair Queuing (WFQ) and it was observed that PQ and WFQ algorithms are the most suitable to get better VoIP QoS. Least number of VoIP calls that can be preserved in MPLS and predictable IP networks with satisfactory quality are estimated in [7] which can help the network designers to decide the number of VoIP calls that can preserved for a given network by reproducing the real network on the OPNET simulator.Priority Queuing (PQ) and Modified Weighted Round Robin (MWRR) Queuing have been proposed in [8] because they perform better for real time applications

They simulated the combinations of Priority Queuing (PQ) and Modified Weighted Round Robin (MWRR) and analyzed their impact on the performance network. A comparative analysis of three queuing systems FIFO, PQ and WFQ is presented in [9].They studied some issues like Traffic dropped Traffic Received and packet end to end delay and result shows that WFQ technique has a better-quality than the other techniques. [10] Describes the performance evaluation of voice over IP/MPLS networks using OPNET tool. The simulation is done by running VoIP application in different network scenarios with different routing protocols and with different queuing techniques to measure quality of service. In [11] the authors presented an analysis of the effect of different queuing techniques on the performance of VoIP using multipath dynamic routing.

3. OPNET SIMULATOR

The simulation tool used in this study is Optimized Network Engineering Tools (OPNET) version 14.0. OPNET is an object-orientated simulation tool for building network modelling and QoS analysis of simulation of network communication, network devices and protocols. OPNET Modeler has a massive number of representations for network elements, and it has many different real-life network construction capabilities. These make real-life network ambience simulations in OPNET very close to actuality and present full phases of a study. OPNET also consist of features such as broad library of network protocols and models, user friendly GUI (Graphical User Interface). OPNET doesn't have any programming knowledge so that it's easy to use and to deal with for any person [7].

4. NETWORKDESIGN AND CONFIGURATION

The below configurations are applied in the Opnet Modelerand simulated to get results.

1.Both the routers are connected together with bidirectional PPP_DS1link.

2. The Work stations and the servers are connected to routers with bidirectional 10Base_T links.

3. In the field of FTP application "High Load" has been selected, Constant (10) to Inter-Request Time and Constant (1000000) to File Size are consigned.

4. In the field of Video Application "Low Resolution Video" has been chose for Video Conferencing, Streaming Multimedia (4) to **ToS** is consigned.

5. In field of VoIP application PCM Quality Speech to Voice and Interactive Voice (6) to ToS is consigned.

6. Different queuing techniques in the routers can change the performance of the applications and the utilization of the network resources. So routers need to be constructed for those three Queuing disciplines. The configurations are given Figs. 2 (a)-(c).

7. Figure 1 shows network architecture for different queuing techniques.

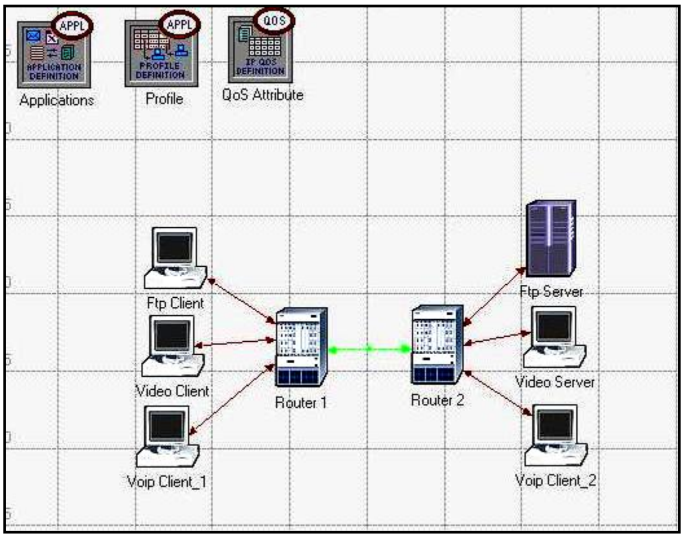

Fig. 1 Network Architecture for FIFO, PQ and WFQ

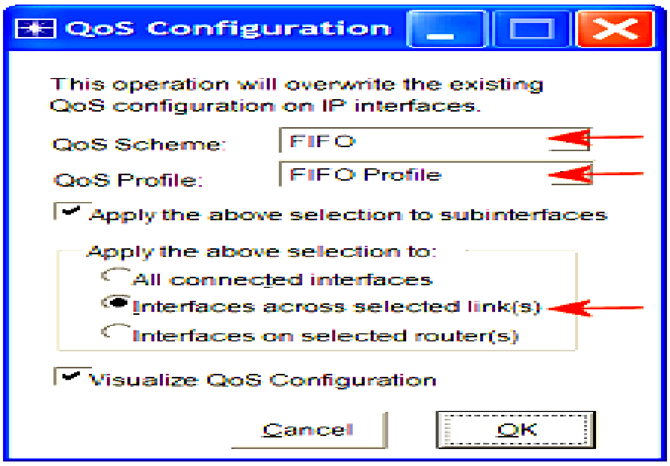

Fig. 2 (a) Configuration for FIFO

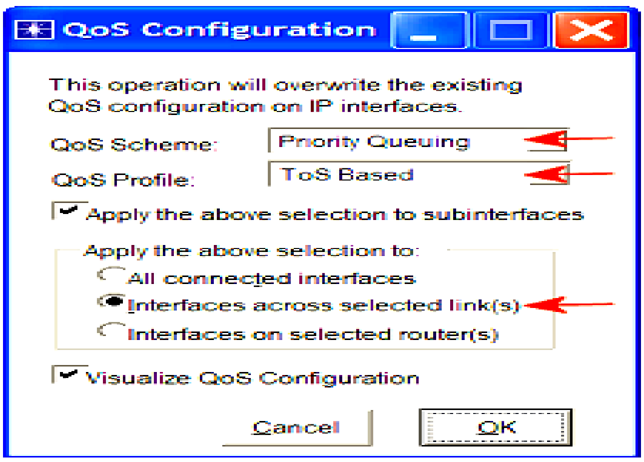

Fig. 2 (b) Configuration for PQ

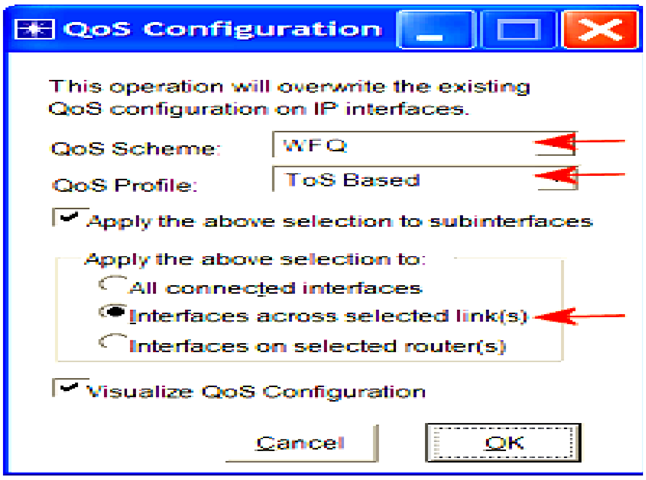

Fig. 2 (c) Configuration for WFQ

5. SIMULATION AND ANALYSIS

Simulations have been carried using OPNET software for every queuing scheme in terms of packet dropping, traffic receiving, packet end-to-end delay etc and it is tested for Video Conferencing, Voice Traffic and FTP.

A. Traffic Dropped

Figures 3shows traffic dropping information, where it can be examined that in the cases of FIFO, PQ, WFQthe packet drop starts at near1m40 sec. Packet drop for FIFO is higher, PQ is lower than FIFO and higher than WFQ. WFQ has lowest packet drop compare to PQ and FIFO.

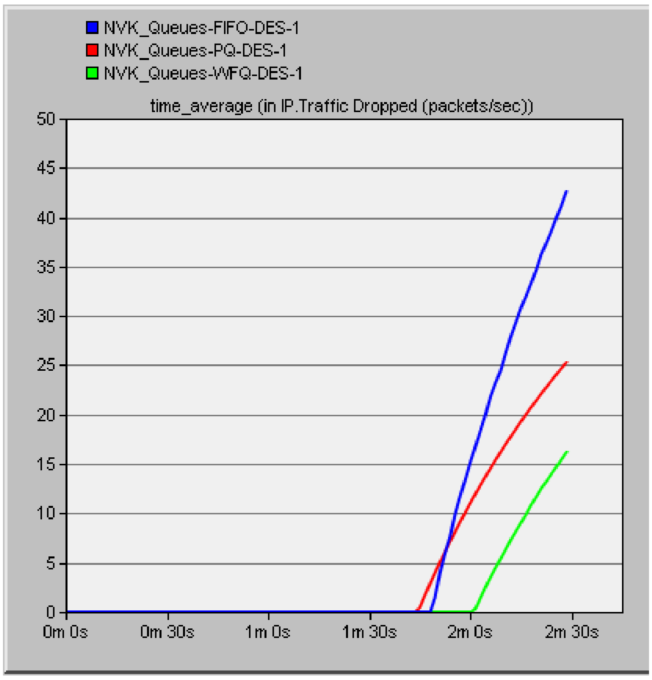

Fig. 3 Traffic drop for FIFO, PQ and WFQ

B. Traffic Received for FTP

Figure4shows traffic received data for FTP, where it can be examined that as the traffic increased the file receiving performance graph line is same in for FIFO and WFQ and in case of PQ, file receiving rate is almost zero.

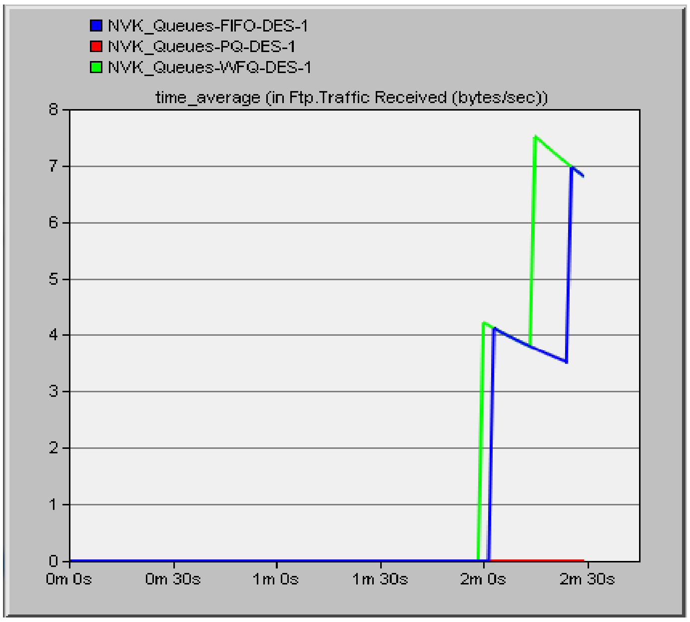

Fig. 4 FTP Traffic received for FIFO, PQ and WFQ

C. Traffic Received for VoIP

Figure 5shows traffic received statistics for VoIP, where it can be examined that as the traffic increased the performance graph line increased in both PQ and WFQ. The performance graph line of FIFO is always lowered compared to the PQ and WFQ.

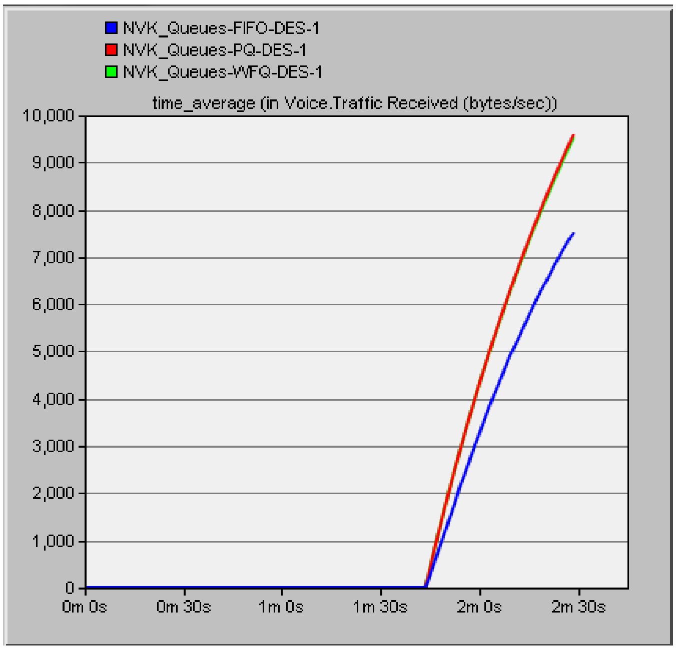

Fig. 5 VoIP Traffic received for FIFO, PQ and WFQ

D. Traffic Received for Video

Figure 6shows traffic received information for Video conferencing, where it can be examined that in cases of FIFO, PQ, WFQ video receiving rate graph WFQ is always superior than the performance graph of FIFO and PQ is lower than the other two.

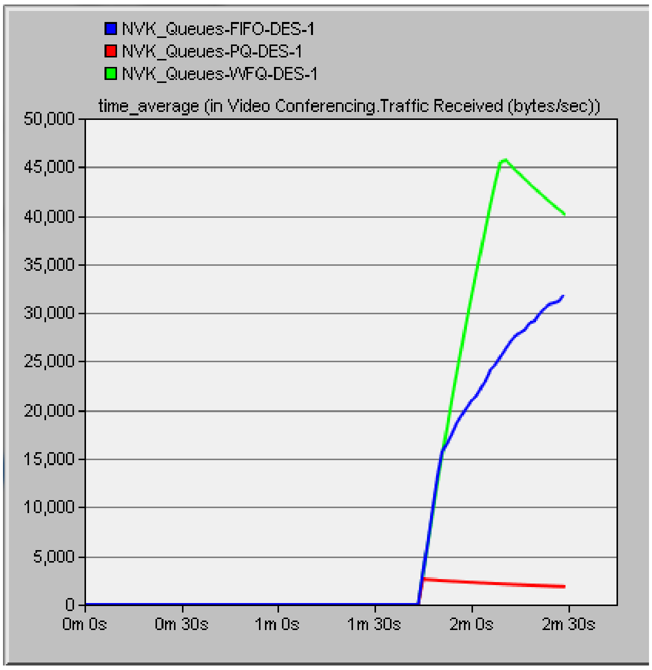

Fig. 6 Video Traffic received for FIFO, PQ and WFQ

E. Packet End To End Delay for VoIP

Figure 7shows Packet end to end delay time for VoIP. For both the cases such as time increase or traffic increase PQ and WFQ packet end to end delay line constantly shows the same characteristics that is packet end to end time delay is nearly zero. FIFO is always higher.

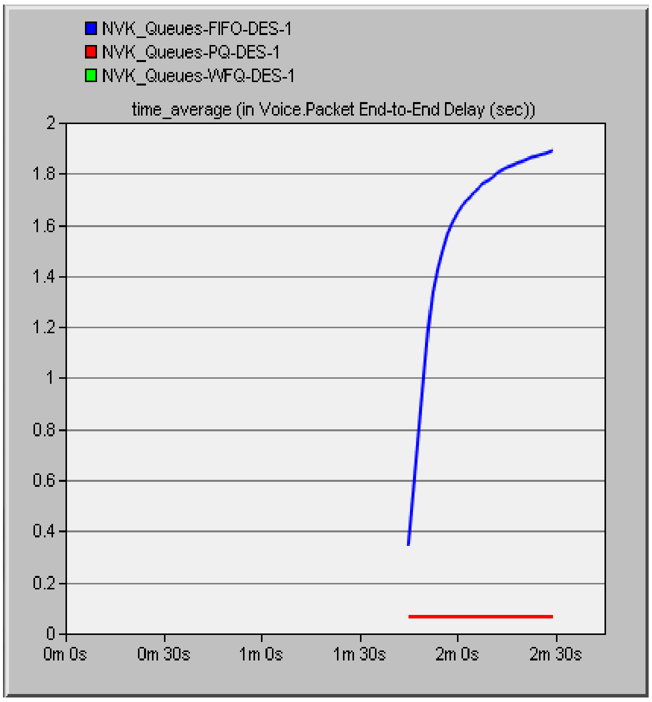

Fig. 7 Voice packet end to end delay for FIFO, PQ and WFQ

F. Packet End To End Delay for Video

Figure 8shows Packet end to end delay time for Video conference, where it can be observed that Packet end to end delay time is higher for WFQ compare to PQ and FIFO.

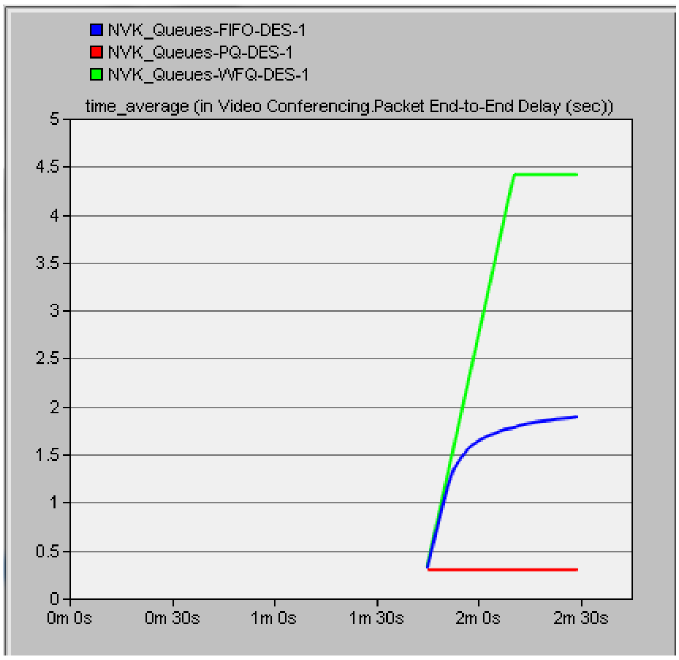

Fig. 8 Video packet end to end delay for FIFO, PQ and WFQ

G. Packet Delay Variation for VoIP

Figure 9shows Packet delay variation time for VoIP, for all the cases such as time increase or traffic increase PQ and WFQ packet delay time line always shows the same features that is packet delay time is nearly zero and for FIFO it is always higher.

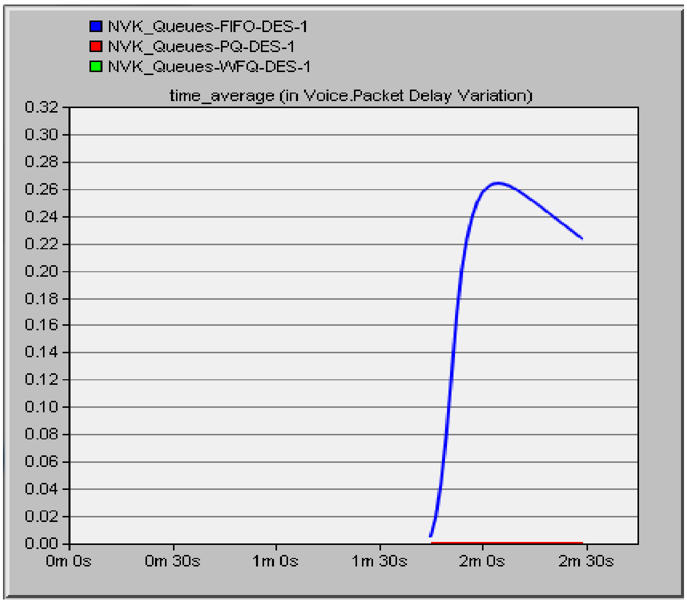

Fig. 9 Voice packet delay variation for FIFO, PQ and WFQ

H. Packet Delay Variation for Video

Figure 10shows Packet delay variation time for Video conference, where it can be observed that Packet delay variation time is higher for WFQ compare to PQ and FIFO.

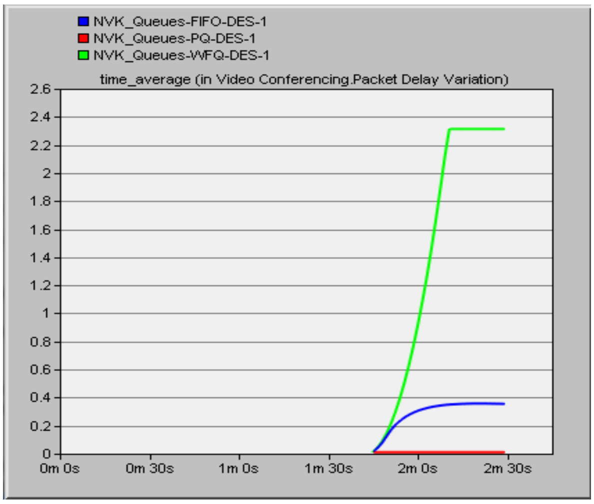

Fig. 10 Video packet delay variation for FIFO, PQ and WFQ

Table 1 Simulation Results

Parameters	FIFO	PQ	WFQ
IP Traffic drop (packets/sec)	645.96	429.64	168.24
FTP Traffic received (bytes/sec)	77.708	0	111.515
Video Traffic received (bytes/sec)	4569.58	435.65	6634.36
Voice Traffic received (bytes/sec)	853.2	1103.84	1098.95
Video Packet end to end delay (sec)	47.22	8.93	95.95
Voice Packet end to end delay (sec)	47.28	1.97	1.97
Video Packet delay variation	8.67	0.32	43.64
Voice Packet delay variation	6.31	0.00026	0.00026

6. CONCLUSION

After the evaluation of the results it is clear that in case of PQ the performance always depends on traffic's number and shows improved output even when the number of client's increases and its performance is superior to FIFO in some cases. FIFO performance is also better in some cases evaluated with PQ. Now, if we compare WFQ with FIFO and PQ in case of traffic drop, File receiving, voice data receive and video conferencing; WFQ always shows the best performance amongst them. So, it can be said that user traffic stream like voice, video, data can be simply transmitted with its efficient level performance by using Weighted Fair Queue algorithm in routers where the voice, video and data streams are routed to go to their needed destination.

In future, we can analyze the above queuing disciplines by increasing the number of routers in the network and then result can be analyze to decide which technique is better for different size of network and applications such as voice and video. Because they are sensitive to delay which cause the voice and video signal to jerk and sputter.

7. REFERENCES

[1] T. Velmurugan, Himanshu Chandra, and S. Balaji,"Comparison of Queuing Disciplines for Differentiated Services using OPNET", in International Conference On Advances in Recent Technologies in Communication and Computing (ARTCom'09), IEEE, October 2009, pp. 744-746.

[2] Mohammad Mirza Golam Rashed. A Comparative study of different Queuinging technique in voip,video conference and file transfer. Dept of ETE, Daffodil International University.2011

[3] Mitko Gospodinov, "The affects of different queuing disciplines over FTP, Video and VoIP Performance", in International Conference On Computer Systems and Technologies -CompSysTech, 2004, pp. 19-1 –19-5

[4] Salil Bhalla, Kulwinder Singh Monga,Rahul Malhotra,"Optimization of Computer Networks using QoS" in International Journal of Engineering Research and Applications (IJERA) Vol. 2, Issue 3, May-Jun 2012, pp.2276-2281

[5] Payal, Richa Gupta,"Review on Optimization of Computer Networks using QoS" in International Journal of Advance Research In Computer Science and Advance Engineering (IJARCSSE) Vol. 4, Issue 4, April 2014, pp.1003-1006

[6] Dr. Hussein A. Mohammed, Dr. Adnan Hussein Ali, Hawraa Jassim Mohammed, "The Affects of Different Queuing Algorithms within the Router on QoS VoIP application Using OPNET", International Journal of Computer Networks & Communications (IJCNC) Vol.5, No.1, January 2013, pp 117-124

[7] KeerthiPramukh Jannu , Radhakrishna Deekonda , "OPNET Simulation of Voice over MPLS with Considering Traffic Engineering " Thesis , Department of Electrical Engineering , Blekinge Institute of Technology , Sweden ,June 2010

[8] Sajad Farhangi, Saeed Golmohammadi , "A comparative study between combination of PQ and MWRR Queuing techniques in IP network based on OPNET " , Advances in Computer Science and its Applications, ACSA, Vol.1, No. 1, pp. 63-66, March 2012

[9] K.Balasundaram, T.Velmurugan, R.Suresh , "Performance Analysis of Queuing Disciplines for Difference Services Using OPNET Tool"International Journal of Scientific Engineering and Technology (ISSN : 2277-1581) Volume No.3, Issue No.1 pp : 47-50 1 Jan 2014

[10] Azeddien M. Sllame, Mohamed Aljafari, "Evaluating the Impact of Routing and Queuing Techniques on the QoS of VoIP Over IP/MPLS Networks" International Journal of Innovative Research in Computerand Communication Engineering Vol. 2, Issue 12, December 2014

[11] Vijayakumar V.Karthikeyani, Mohamed Omar: Implementation of Queuing Algorithm in Multipath Dynamic routing architecture for effective and secured data transfer in VoIP, International Journal of Engineering Trends and Technology (IJETT), Vol. 4, No. 4, pp.1226-1230, April 2013.