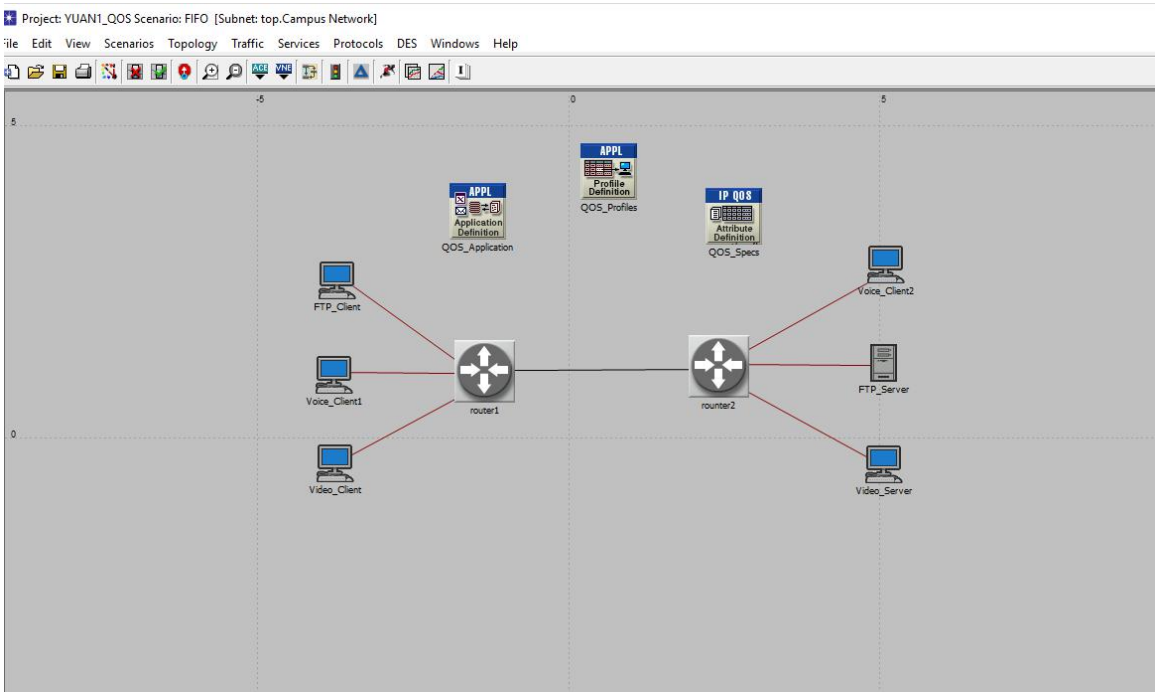
QOS in IP Networks

Course : Computer Networks/Telecomms

Yuan Wang
A00258427

1. Aim

This experiment needs to use OPNET to create a simple network carrying 3 types of traffic: data, voice, and video. And initially observe the performance of a basic FIFO mechanism handling the traffic, and then use the DSCP field to classify these different traffic flows. We need to build a simple network which was linked by two routers and each router have three different type server or client link with them, after that, we need to create some different scenarios and leaving only those links that respond to each other. And we run these scenarios separately collect data and analysis different queuing mechanisms on packet delivery and delays for different services. All single link network base on the first simple network and the basic simple network should be look like this image:



2. Objective

This experiment will examine the effect of different queuing mechanisms on packet delivery and delays for different services.

3. Introduction/background

QOS: is the set of techniques to manage network resources.[7] The required quality of service is achieved by managing network delay, delay variation, bandwidth and packet loss parameters.QOS can provide better service capability for the network is a security mechanism of the network or a means to solve network delay and congestion.

FTP:File Transfer Protocol is a standard network protocol used for the transfer of computer files between a client and server on a computer network.[1]The objectives of FTP are to promote sharing of files (computer programs and/or data), to encourage indirect or implicit (via programs) use of remote computers, to shield a user from variations in file storage systems among hosts, and to transfer data reliably and efficiently. FTP, though usable directly by a user at a terminal, is designed mainly for use by programs.[2]

First-In-First-Out:Is an acronym for first in, first out, a method for organizing and manipulating a data buffer, where the oldest (first) entry, or 'head' of the queue, is processed first. It is analogous to processing a queue with first- Come, first-served (FCFS) behavior.[4]FIFO is the simplest of the queuing mechanism. There is a FIFO queue on each interface. On the surface, the FIFO queue does not provide any QoS (quality of service, quality of service) guarantee. In fact, FIFO is the basis of other queues, FIFO affects the key indicators of QoS.

PQ:Priority Queuing,is a Congestion Management technique. PQ schedules traffic such that the higher-priority queues "always" get serviced first. [5] It has strict priority control. The higher the priority, the earlier the allocation is performed. It is a blocking control mechanism that guarantees the transmission queue order.

WFQ: Weighted Fair Queuing, is a network scheduler scheduling algorithm.[3] In order to provide fair scheduling between streams, WFQ allocates the same bandwidth to each stream. Its have some advantages like :WFQ will not let any stream get no processing opportunities, and can guarantee the throughput of all streams;WFQ configuration is simple, no need to display classification.

Voice over IP:VoIP, which stands for Voice over Internet Protocol, in its basic form is the transmission of voice traffic over IP-based networks as opposed to voice over the traditional PSTN (Public Switched Telephone Network).[6]Speech recognition usually only analyses the voice signal input by the player, identifies specific words and phrases, and then triggers events according to it. However

VoIP, it can capture, compress and broadcast through LAN or Internet, thus achieving the integrity between users. Exchange voice signals accurately.

4. Method

This experiment can be divided into two part:

Part One:

1) Create first scenario named FIFO.

2) Pull a Application Config object from internet_toolbox Right click this object select set attributes and set the name attributes to QOS Applications.

3) Expand the Application Definitions attributes set the row attributes to 1.Expand the row 0 attribute set name to FTP_QOS.

4) Expand the Description attribute and edit the value of FTP, select high load and edit. Set the type of service to Best Efforts(0) and Inter-Request Time to constant(1).

5) Expand the Application Definitions attributes set the row attributes to 2.Expand the row 1 attribute set name to Voice_QOS.

6) Expand the Description attribute and edit the Voice attribute, select PCM Quality Speech and edit. Set the type of service to Best Efforts(0).

7) Expand the Application Definitions attributes set the row attributes to 3.Expand the row 2 attribute set name to Video_QOS.

8) Expand the Description attribute and edit the Video attribute, select Low Resolution Video and edit. Set the type of service to Best Efforts(0) and the Frame Interarrival Time to 0.15 sec.

9) Pull a Profile Config object from internet_toolbox right click this object set attributes, set name to QOS_Profile.

10) Expand the profile configuration, set FTP Profile, Voice Profile, Video Profile separately.

11) Pull 5 ethernet_wkstn, 1 ethernet_server, 2 etherne4_slip8_gtwy routers,1 QOS Attribute Config from internet_toolbox.Interconnect routers and the server with 10Base_T, and Interconnect the two routers with a PPP_DS1 link.

12) Deploy the Applications and Click on the connecting the two routers, and from the Protocols main menu select IP, then QOS, then Configure QOS.

13) Run this simple network and create three different scenarios named FTP_ONLY, Voice_Only, Video_Only.

14) In the corresponding scenario, leave the corresponding connection, delete unnecessary connections, and run.

15) Observe and compare these data then get result.

Part Two:

1) Duplicate the fifo scenario and Edit the Applications definitions module. Allocate to each application a DSCP code by clicking on the value field for Type of Service. Select EF for Voice,AF 31 for Video and AF 11 for FTP.

2) Create two different scenarios named named PQ and WFQ.

3) Select PQ scenarios Click on the link connecting the 2 routers, and from the Protocols main menu select IP, then QOS, then Configure QOS.

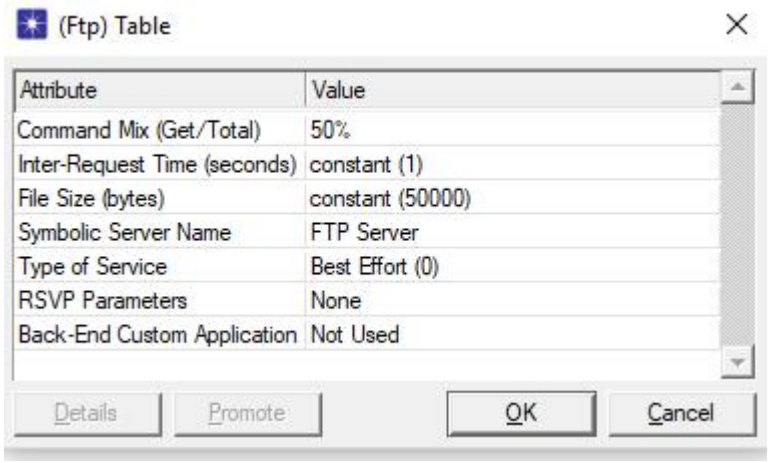
4) Set QOS schema to priority queuing and choose All connected interfaces.

5) Select PWQ scenarios Click on the link connecting the 2 routers, and from the Protocols main menu select IP, then QOS, then Configure QOS.

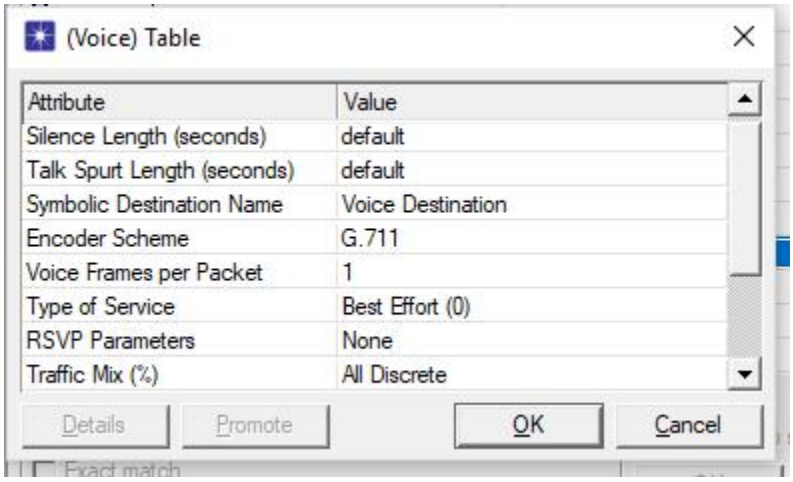
6) Set QOS schema to WFQ and choose All connected interfaces.

7) Observe and compare these data then get result.

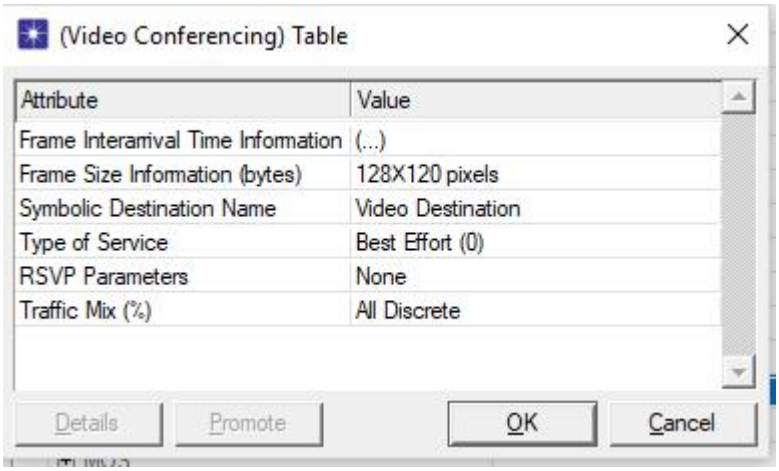
5. Result



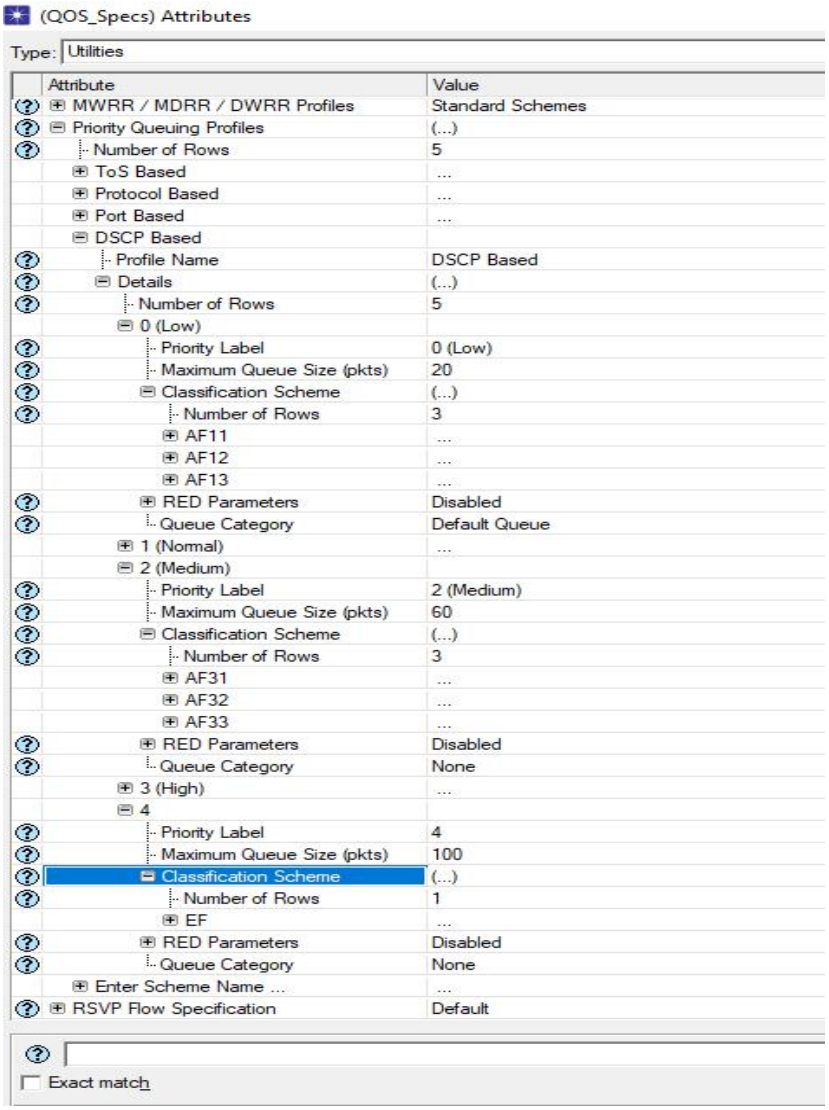
(table1: Table of ftp Quantity of Service)



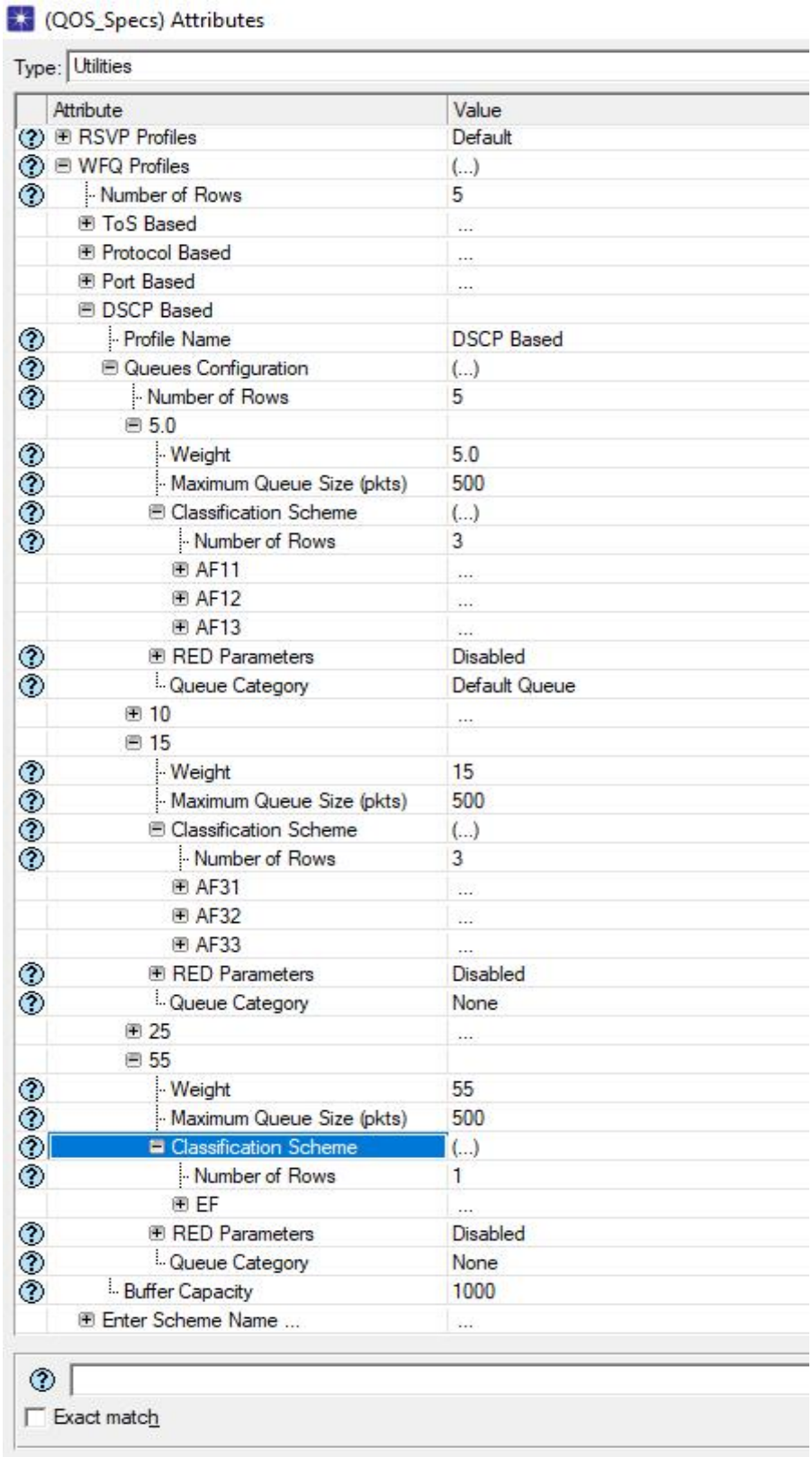
(table2: Table of Voice Quantity of Service)



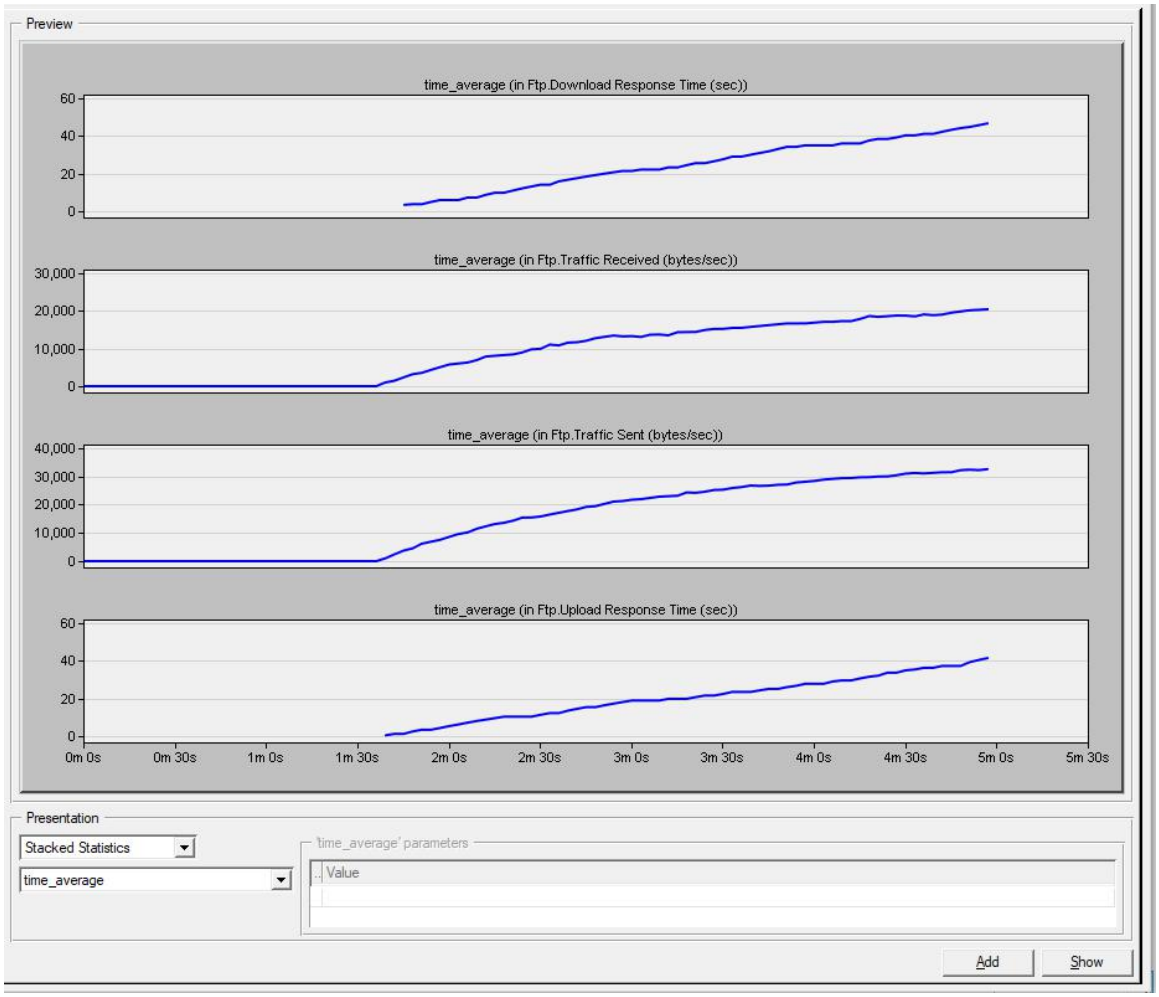
(table3: Table of Video Quantity of Service)



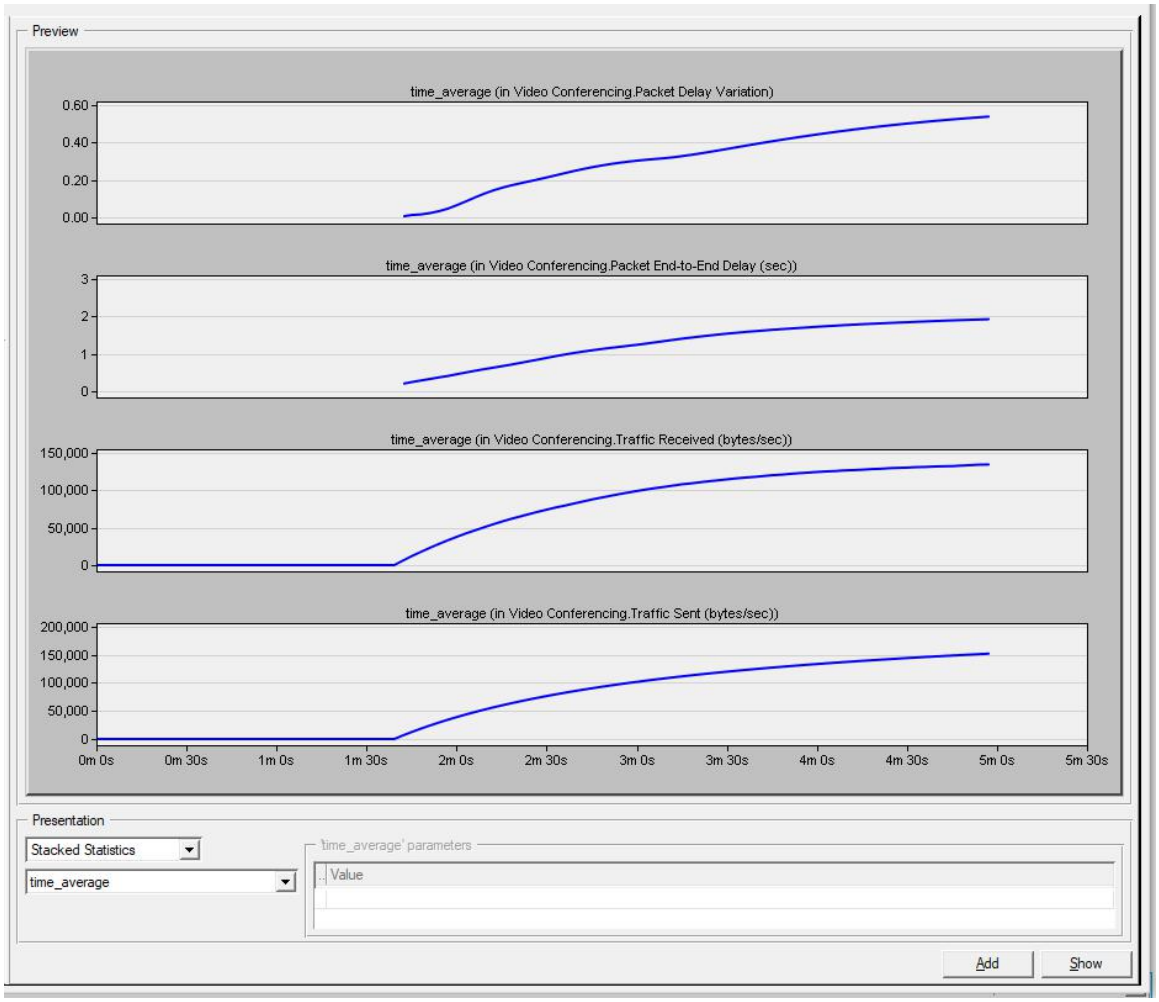
(table4: table of Attributes about Priority Queuing profiles DSCP Based)



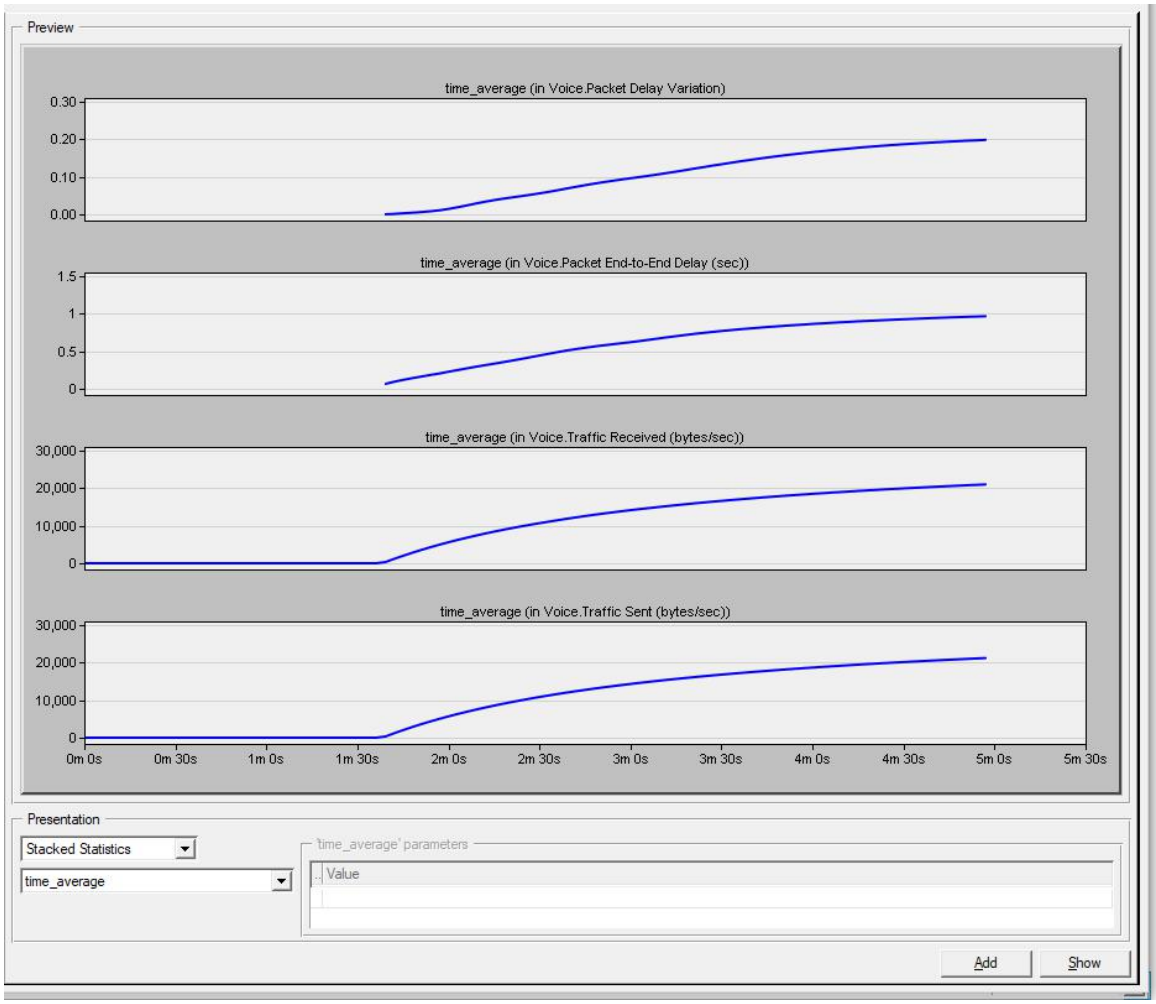
(table5: table of Attributes about WFQ profiles DSCP Based)



(Figure1:Result of FTP in FIFO network)

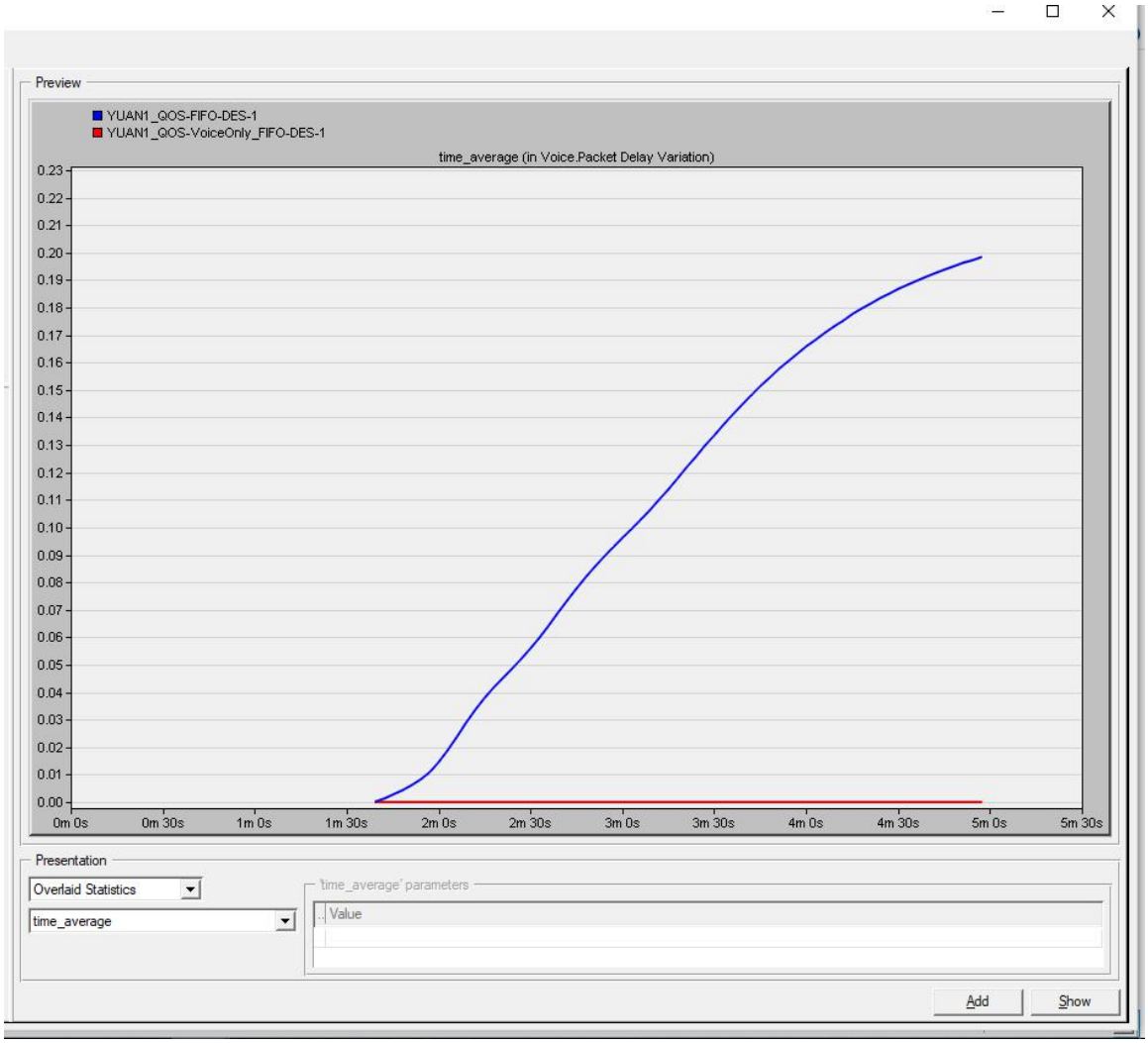


(Figure2:Result of Video in FIFO network)

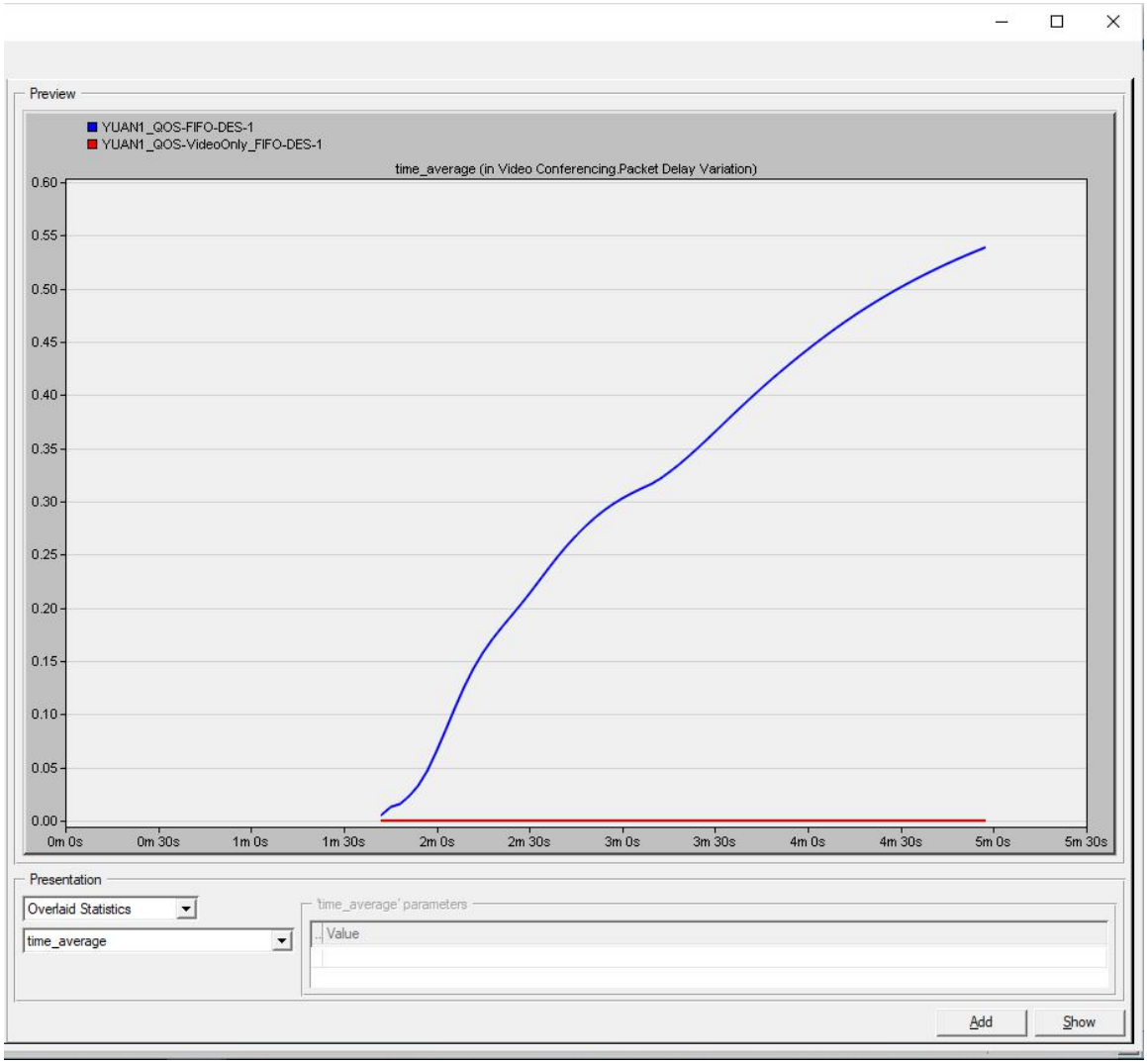


(Figure3:Result of Voice in FIFO network)

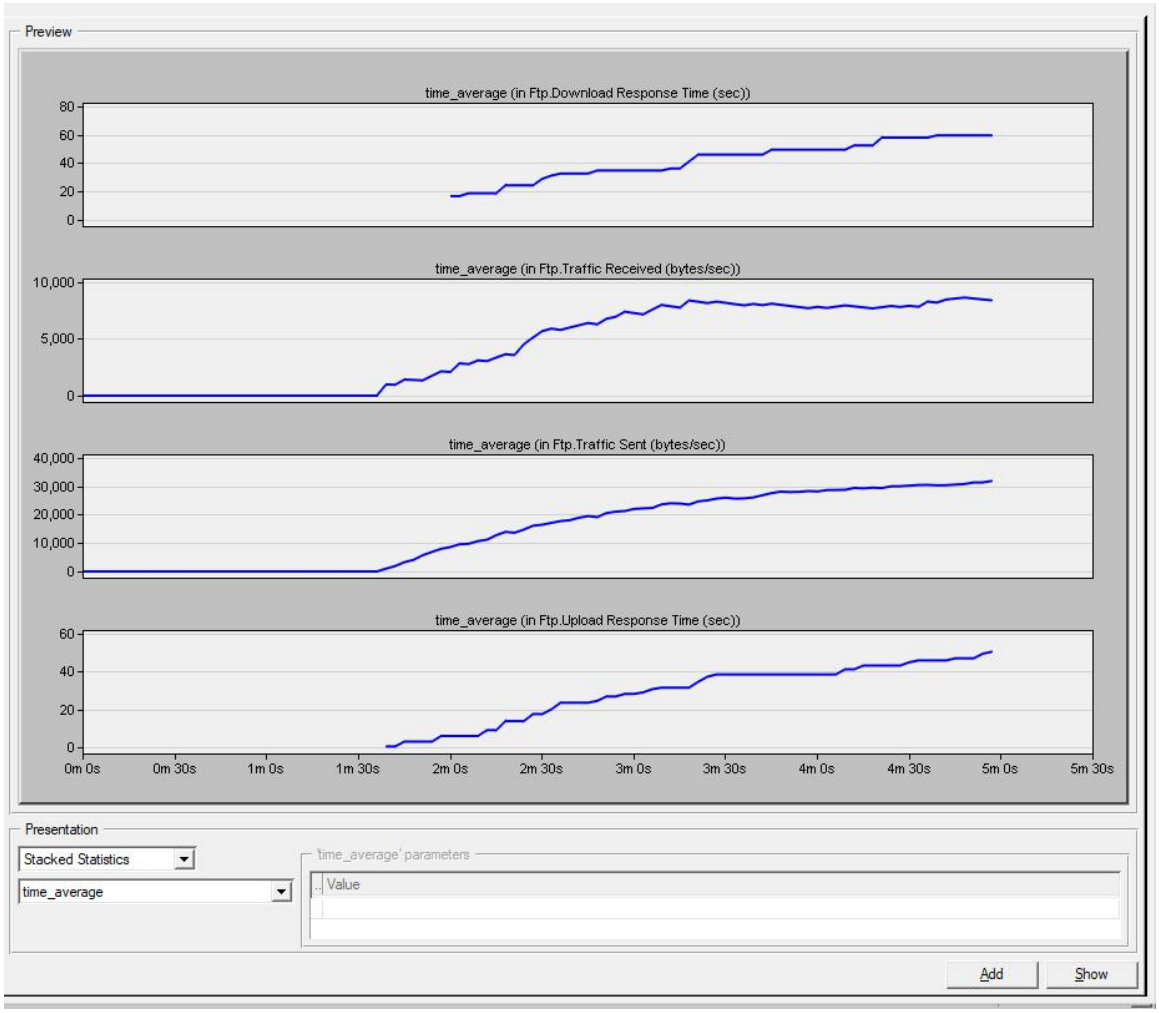
(Figure4:Result of FTP in FIFO network compare with FTP_Only in traffic sent--time Avg)



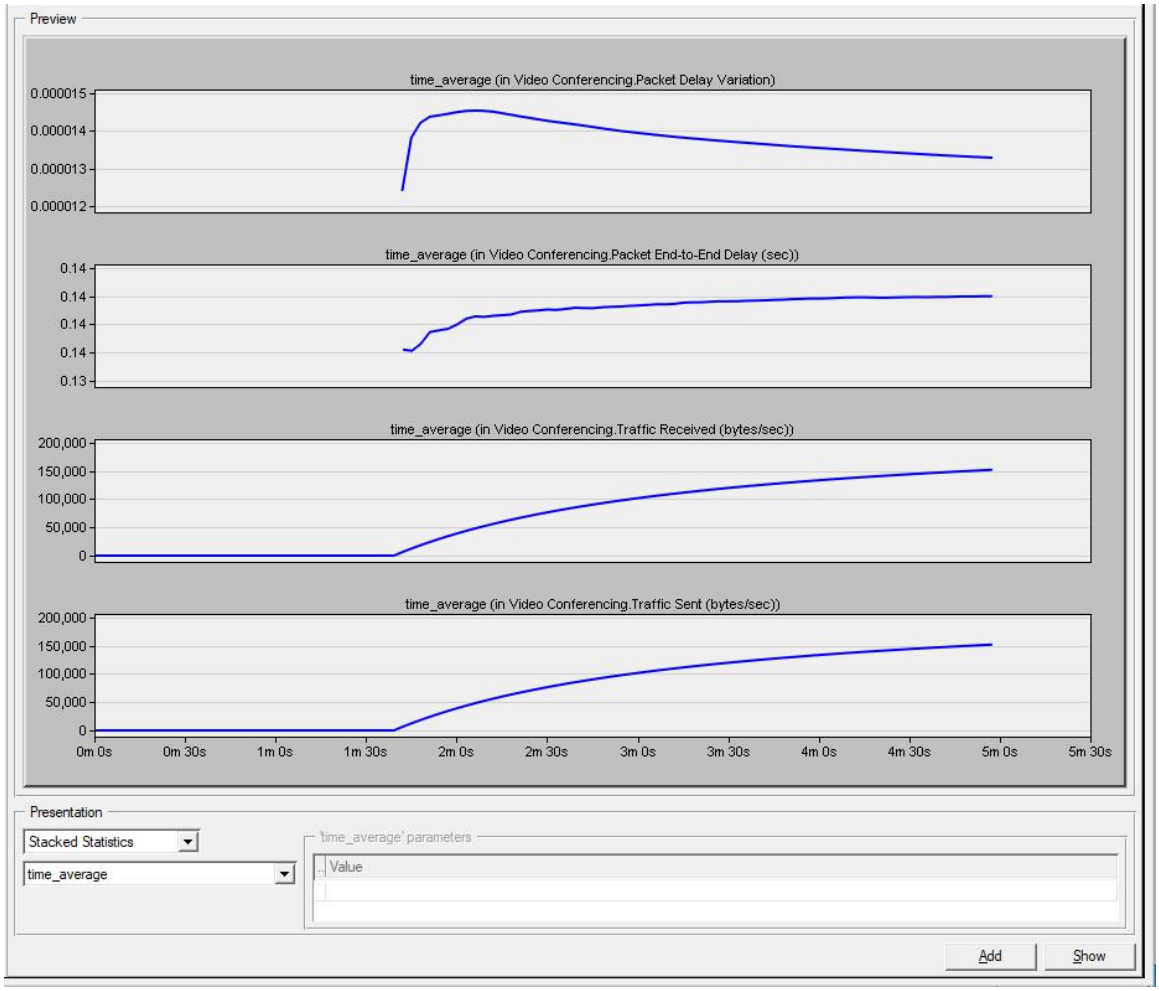
(Figure5:Result of Voice in FIFO network compare with Voice_Only in packet delay variation--time Avg)



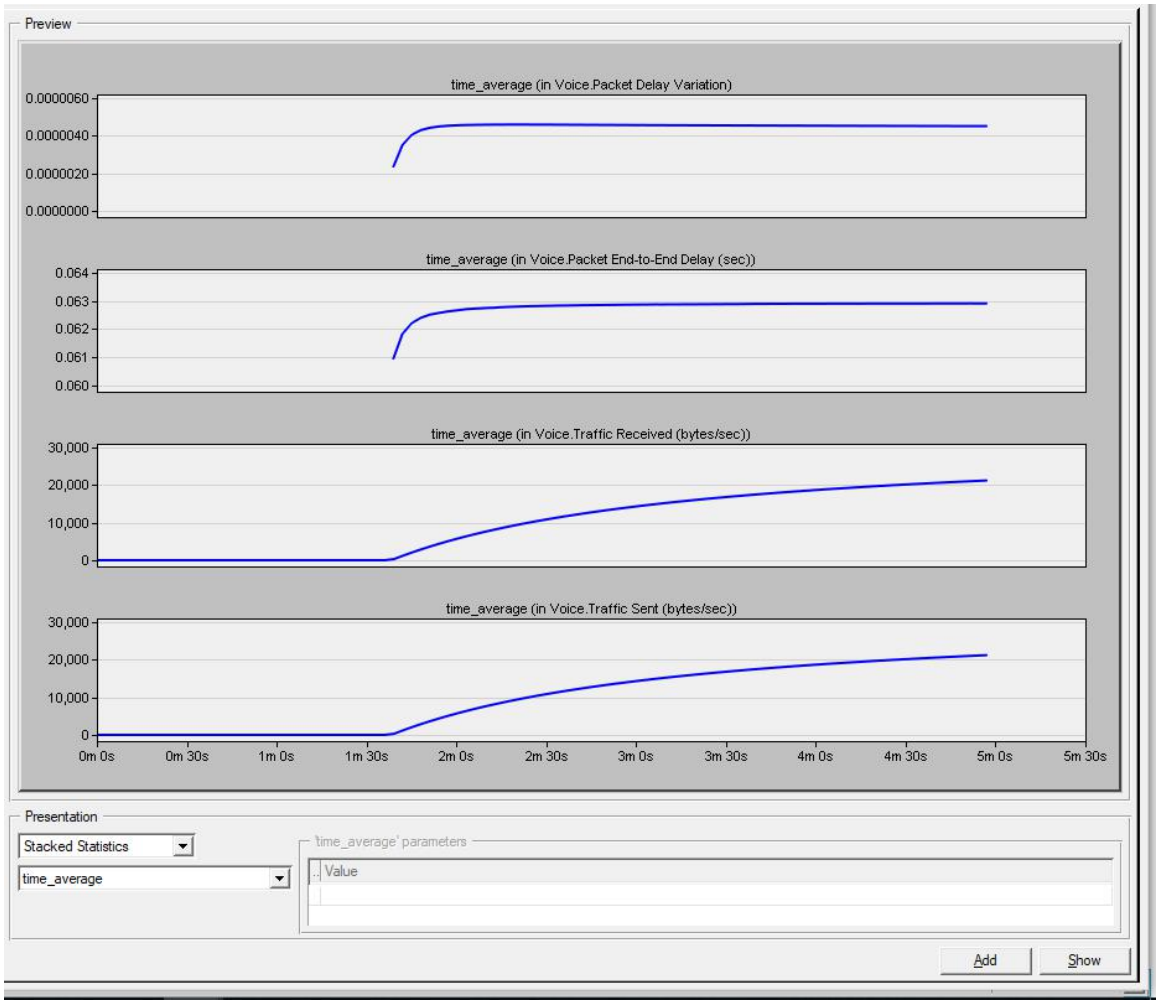
(Figure6:Result of video in FIFO network compare with video_Only in packet delay variation--time Avg)



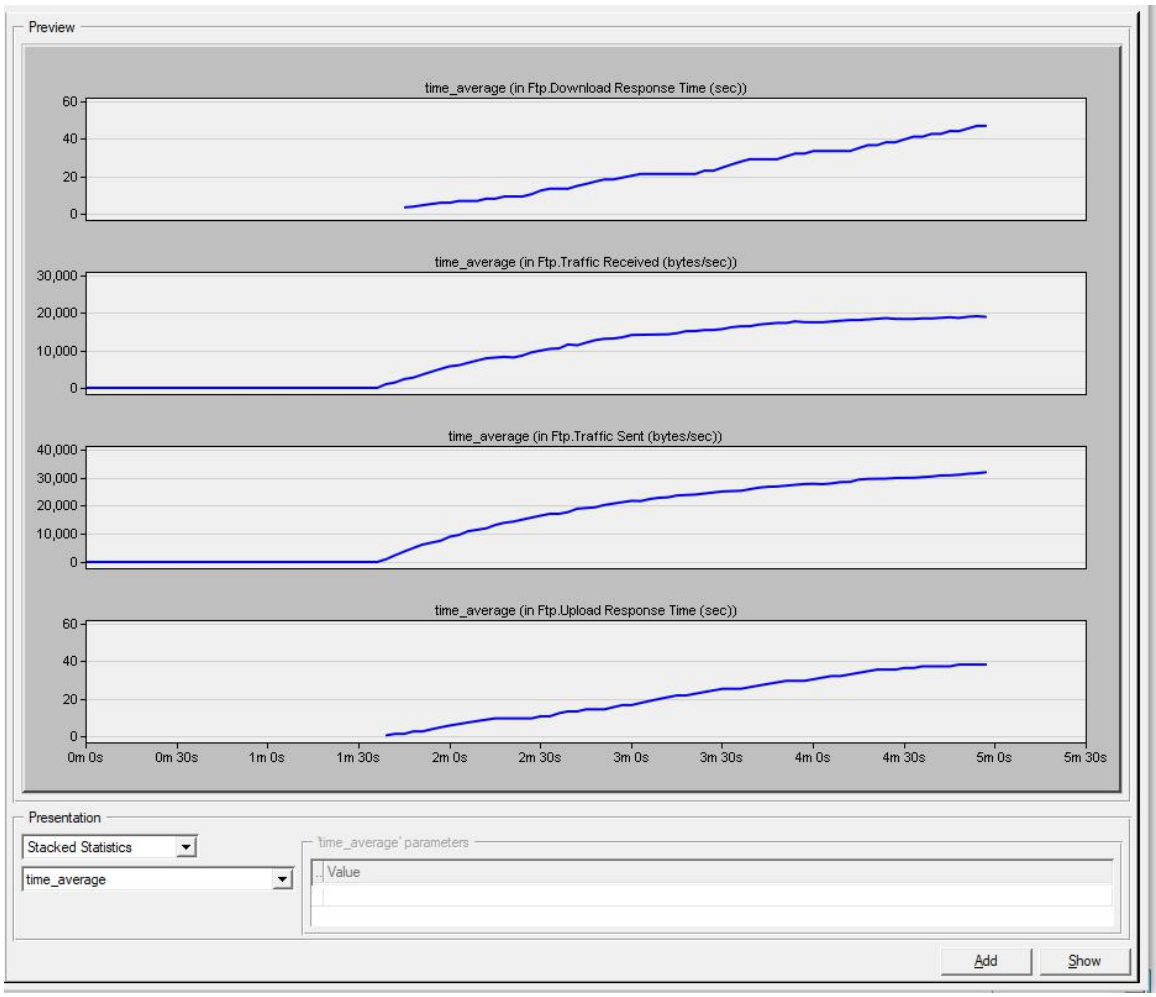
(Figure7:Result of FTP based on QOS schema with priority queuing)



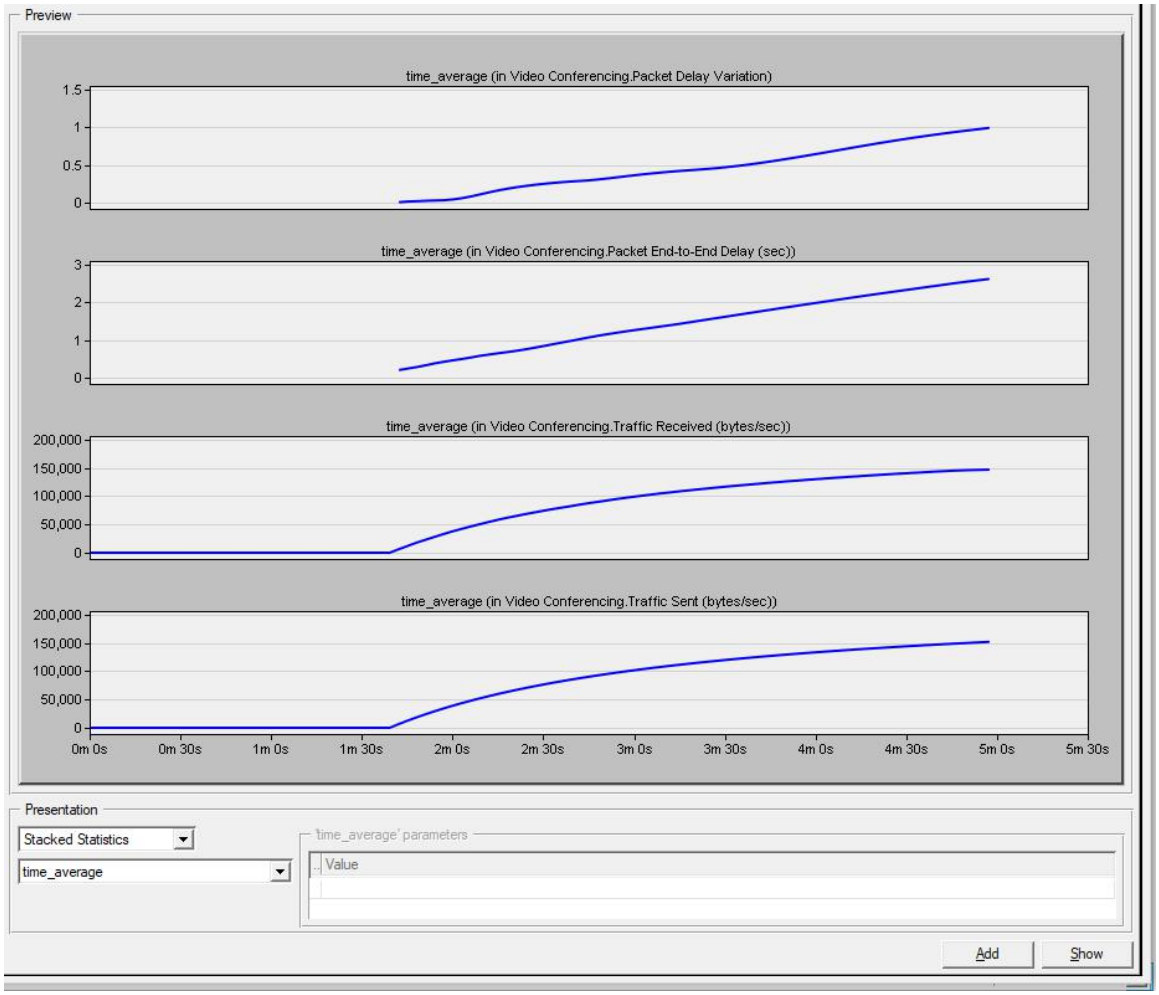
(Figure8:Result of Video based on QOS schema with priority queuing)



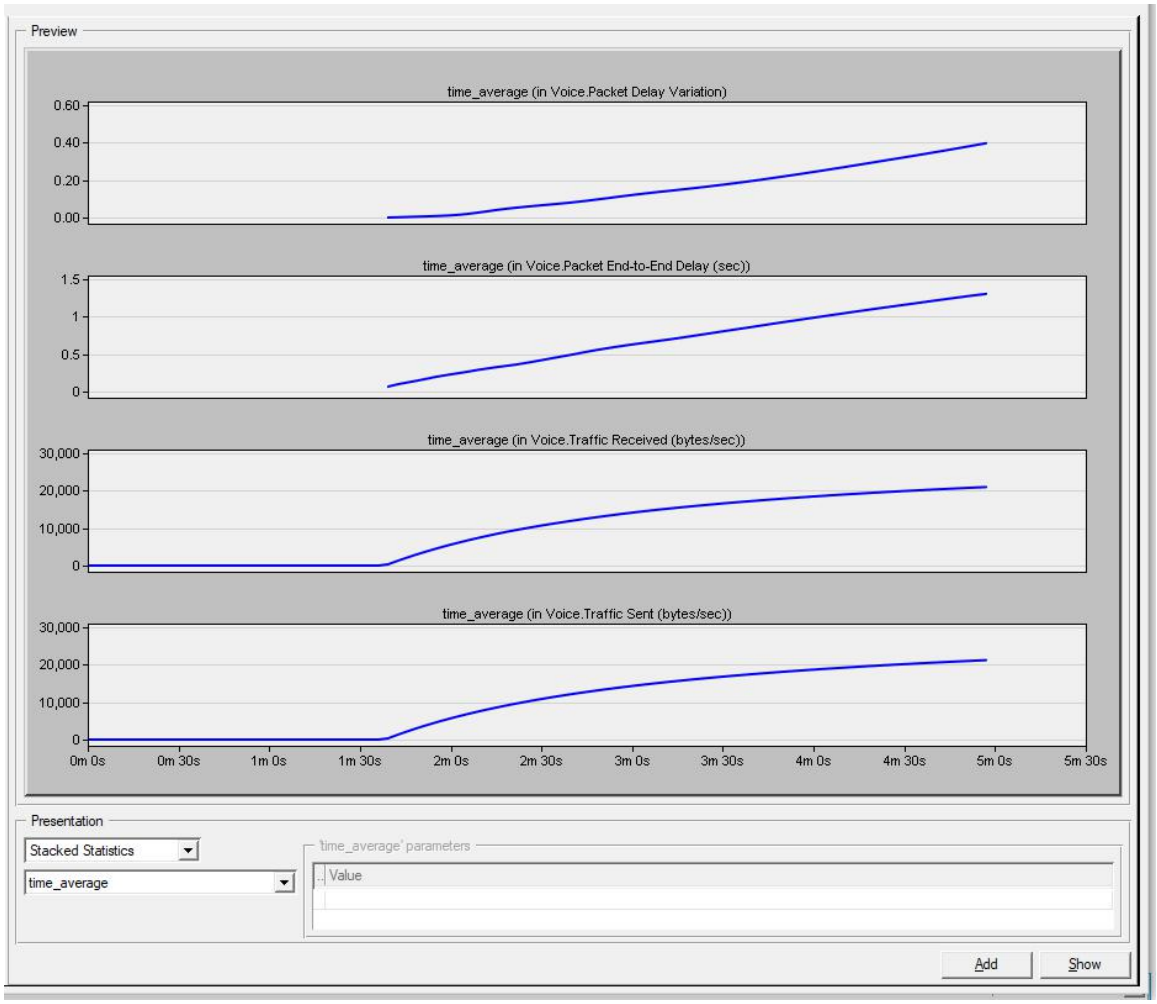
(Figure9:Result of Voice based on QOS schema with priority queuing)



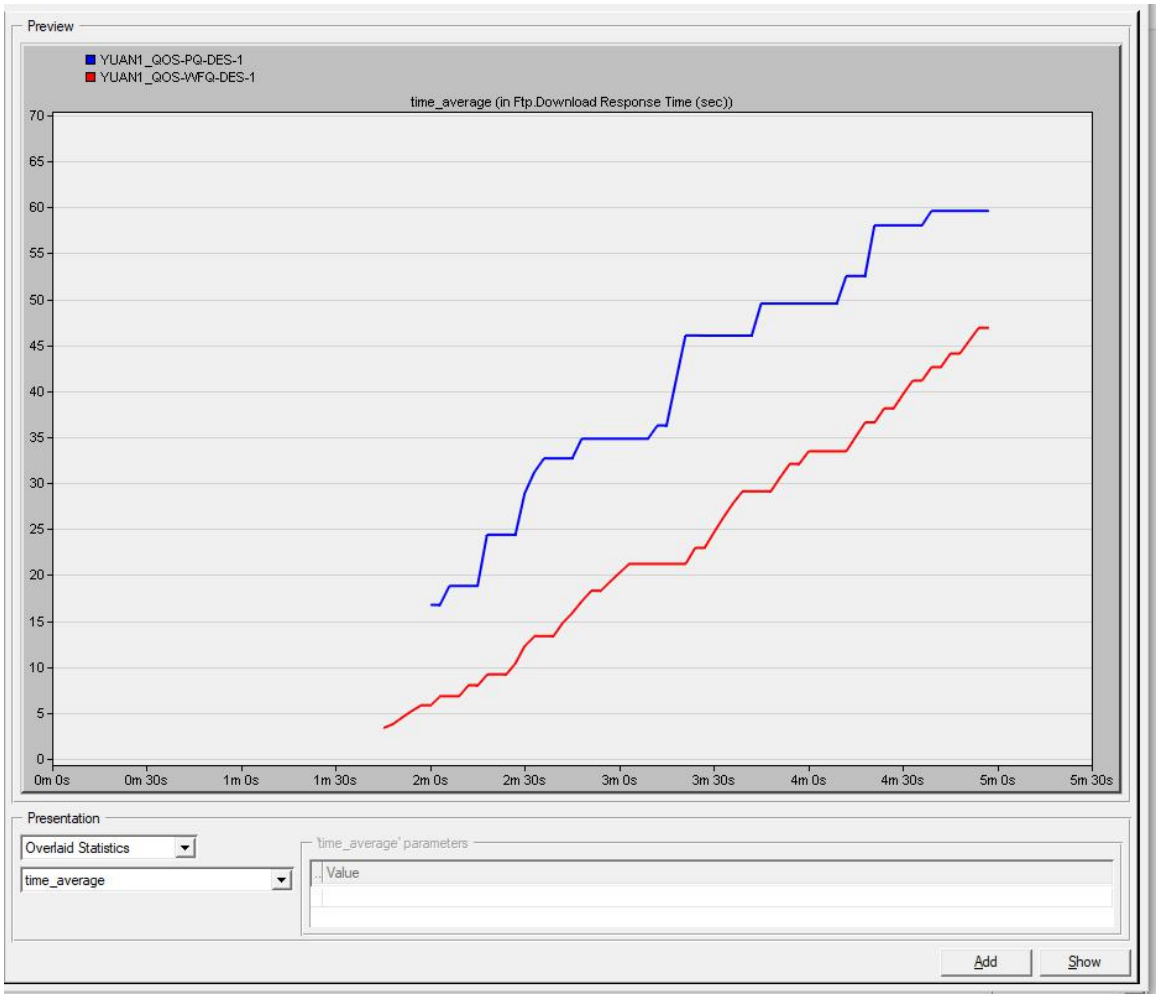
(Figure10:Result of FTP based on IP QOS schema with WFQ)



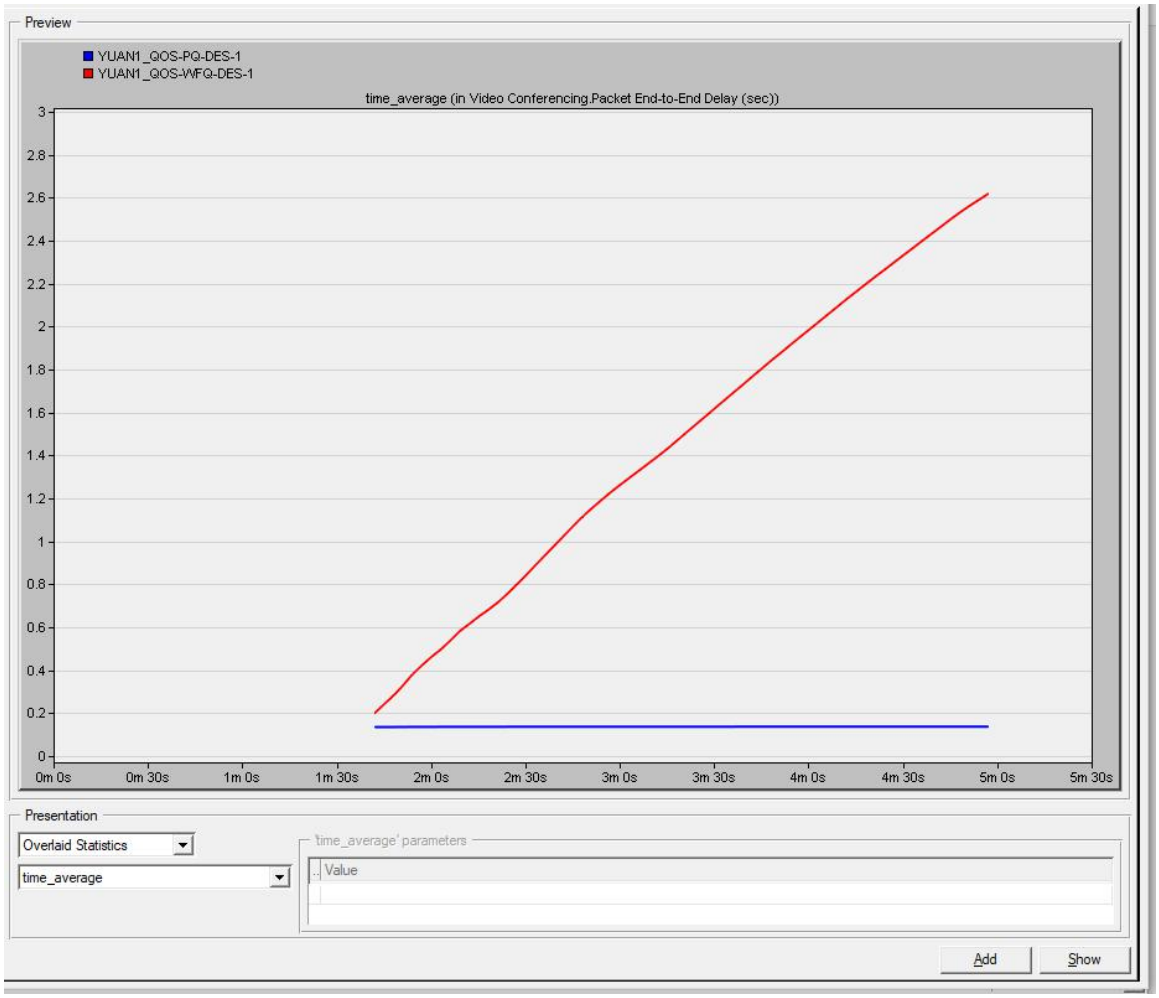
(Figure11:Result of Video based on IP QOS schema with WFQ)



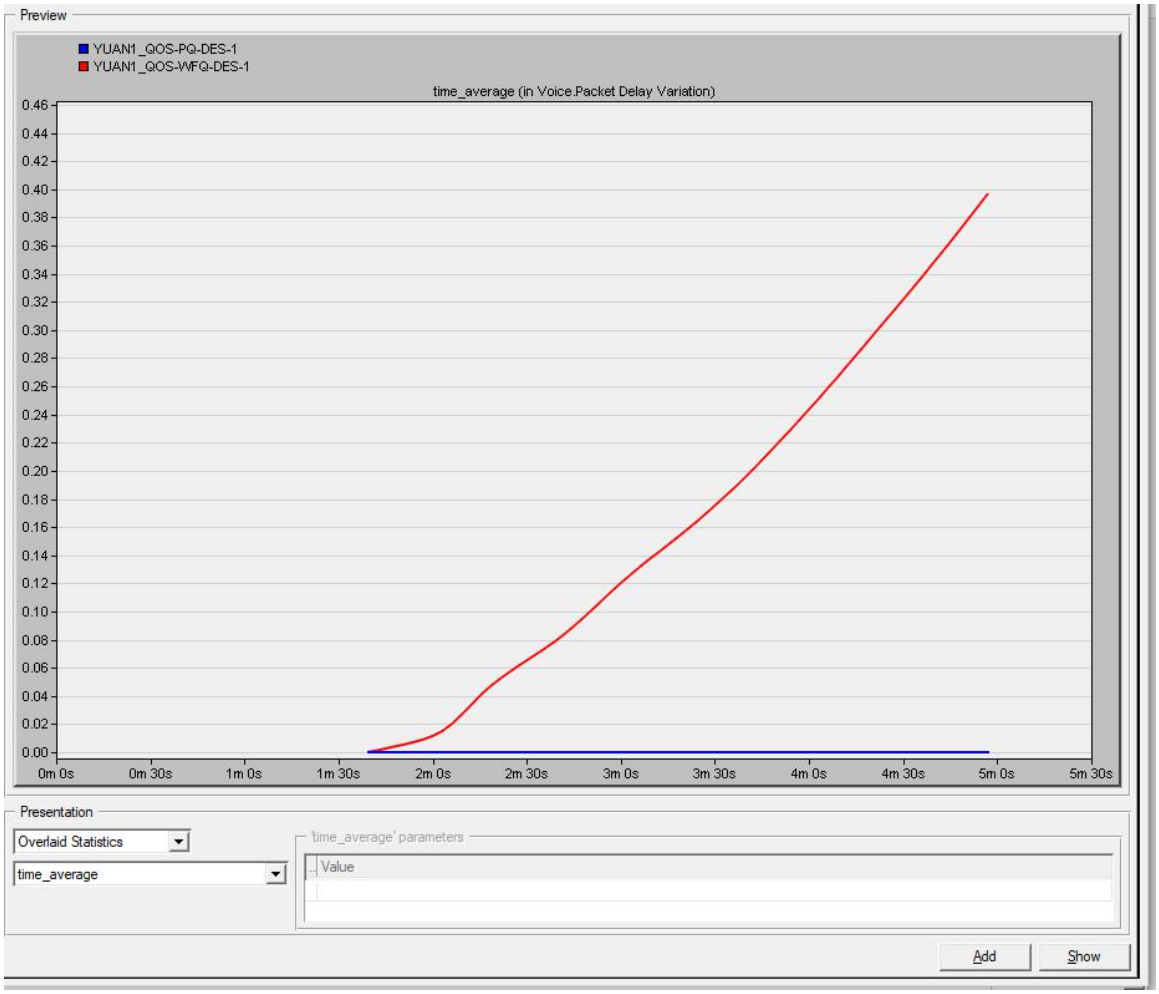
(Figure12:Result of Voice based on IP QOS schema with WFQ)



(Figure13:Result of PQ compare WFQ FTP Download Response Time(bytes sec__time avg))



(Figure14:Result of PQ compare WFQ video Packet end-to-end Delay(sec_time avg))



(Figure15:PQ compare WFQ voice Packet Delay Variation(time avg))

6. Discussion

These graphs and tables in result part display the results from running this experiment.

table1,2&3 display the parameters configuration about the FIFO network scenario in three different types of traffic, because we research the FIFO (first in first out) network so we set all the type of service attributes to best effort(0) means not guarantee the user's Quality of Service level or a certain priority, so as to distinguish from the experiments second part.

Figure1,2&3 display the results about the FIFO network scenario transfer with three different types of traffic FTP, video and voice. Figure1 is the result of FTP transfer in the FIFO network we can see that the download response time and

upload response time have the same trend, traffic sent and traffic received have the same trend.Basically, in FTP result, after 1minute 30seconds, the download and upload response time are increasing with time increased. And the result of traffic sent and received have the same situation in the first 1minute 30seconds, keep stable and after that timestamp, it begins increasing. In the end, the traffic sent was over 30,000 bytes however the traffic received was 20,000 bytes means we had lost 10,000 bytes data.
Figure2&3 separately display the results of video and voice, those two results have same research index and we can see all those traffic set & received in the FIFO network after 1minute 30seconds had begun to increase and traffic sent is great than traffic received.

Figure4,5,6 separate display the result of FIFO network compare with only one traffic type network. Because there is only a single traffic type in the compared network, without others traffic type effect and single traffic type don't need to share the tunnel with others traffic type. So the results of the comparison groups curve are smoother than those of networks that originally operated with multiple traffic types. For example in figure 5, we compare the voice packet delay variation the voice only networks curve always keep table but FIFO networks curve had begun increase after 1minute 30seconds.

Table 4&5 display the parameters configuration table for PQ and WFQ. In table 4 we can see parameter configuration about PQ, and we set FTP to low(0), video to medium(2) and voice to level 4. In table 5 we set Ftp weight to 5, video weight to 15 and voice weight to 55.

Figure 7,8,9 is the second part experiment result about display PQ(Priority Queuing) scenario with three different traffic type. And we can see in the figure 9, all of these result curves was smooth. In figure 8, most of all curves was smooth some curves like package end-to-end delay and package delay variation have a little fluctuation. However in figure 7 which is display FTP set for PQ, we can see that those curves have very obvious fluctuations. The reason for this result is that in this priority queuing network we set voice level to 4 which is the highest level in this network , set video level to medium(2) and FTP level to low(0), so when this network running it first to keep voice traffic type can successfully transfer to the host , then is video and finally is FTP, so that if these three traffic type send together FTP always need to wait transfer after voice and video. So that we get result like this.

Figures 10, 11, and 12 are displays showing the results of the second part of the experiment on WFQ(Weighted Fair Queuing) scenario with three different traffic

types. We can see that the different traffic types are smooth in this case, even though the FTP results still have a little fluctuation in Figure 10. And compare with PQ scenarios FTP result, it also has greatly improved. That is because WFQ splitting these service in weights ensure that transmission capacity is shared fairly , and all traffic types have same opportunity to get transmitted. In table5 we set FTP weights to 5 , video weights to 15 and voice weights to 55.

We can better compare PQ and WFQ with figure13,14 and 15. In figure 13 we compare FTP download response time with this two different queue schema and it shows a very obvious result is that WFQ download always under PQ, and in the end, PQ download response time had touched 60 seconds and WFQ just over 45 seconds. That is because in PQ FTP always need to wait after voice and video to send data but in WFQ, FTP has the fair chance to send data to the response time is lower than PQ. In figure 14 we compare the video package end-to-end delay, we can get that curve of PQ results is keep stable beside 0.2 seconds and curve of WFQ results in the end over 2.6seconds, This is because WFQ does not have strict sequence priority like PQ, it relies on weights to fairly distribute the send queue. And this reason is suited for compare result in figure 15, in this graph we compare the voice Packet Delay Variation with two different queue schema, and in PQ we give voice level4 priority which is the highest level in that queue, so the figure shows that the curve almost close to 0, but the curve of WFQ had increased finally touched 0.4second.

7. Conclusion

In this experiment I create one simple network to analysis QOS in IP network with three different traffic types -FTP, Voice, Video. And run this three different traffic type in FIFO network , Priority Queuing schema network and Weights Fair Queuing schema network. Get results and compare it.

Compare and analysis with those results I think WFQ is better than PQ and FIFO, because it provides a fair queue transmission sorting mechanism, although in PQ, the higher the priority, the faster the data transmission, but in the real network, there is a variety of data transmitted in the network, it is obvious that WFQ will be more suitable.

8. REFERENCE

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