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WIMAX NETWORK PERFORMANCE ANALYSIS OF SCHEDULING QUEUES FIFO, WFQ, MDRR & DWRR USING OPNET TOOL

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Abstract

A wireless revolution is seeking into our daily lives never before. Sooner or later we are all going to go wireless. Broadband Wireless Access has occupied in the market for about a decade. The recently developed Blue tooth wireless technology is a low power, short- range technology for ad hoc cable replacement and it enables people to wirelessly combine devices wherever they bring them. Due to the short-range limitations of Bluetooth, the recent emergence of Wi-Fi.In this paper, presented three different WIMAX Network which are based on different Queue System such as FIFO,MDRR,WFQ & DWRR To Obtain the Performance of WIMAX Network. To check the Performance each Network we have taken different metrics. We have concluded that in out of six, five results go with the favors of WFQ. In this Paper Optimized Network Engineering Tools (OPNET) modeler 14.5 has been used as a simulation environment.

Keywords: WIMAX, FIFO, MDRR, WFQ, DWRR, OPNET

1 Introduction

WIMAX (**Worldwide Interoperability for Microwave Access)** is one of the latest broadband wireless technologies all around today. WIMAX systems are expected to deliver broadband access services to residential and enterprise customers in an economical way. WIMAX is a standardized wireless version of Ethernet intended primarily as an alternative to wire technologies (such as Cable Modems, DSL and T1/E1 links) to provide broadband access to customer premises. More strictly, WIMAX is an industry trade organization formed by leading communications, component, and equipment companies to promote and certify compatibility and

interoperability of broadband wireless access equipment that conforms to the IEEE 802.16 and ETSI HIPERMAN standards. WIMAX would operate similar to Wi-Fi, but at higher speeds over greater distances and for a greater number of users.

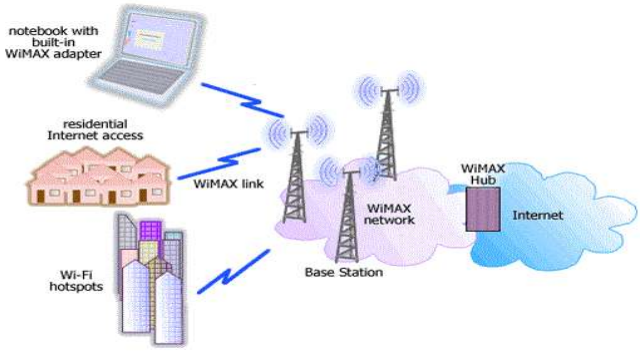

Figure 1.1 WIMAX Model

1.1 FIFO Queuing

In first-in, first-out (FIFO) queuing, packets wait in a buffer (queue) until the node (router or switch) is ready to process them. If the average arrival rate is higher than the average processing rate, the queue will fill up and new packets will be discarded. A FIFO queue is familiar to those who have had to wait for a bus at a bus stop. Under the FIFO method, the earliest goods purchased are the first ones removed from the inventory account.

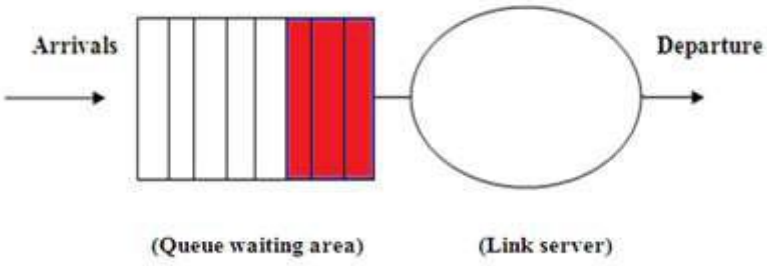

Figure 1.2 FIFO Queuing Model

1.2 Weighted Fair Queuing

When there are too many packets in the network then network performance degrades. Because of excessive packets, buffers in routers overflow leading to packet loss. This ultimately causes increased end to end delay. This is called congestion.Congestion ControlInitially congestion control was considered to be a problem of avoiding buffer exhaustion. But Nagle discovered that if routers have infinite memory then congestion gets worse. This is because by the time packets get to front of queue, they have already been timed out and duplicates are already sent. All these packets will be dutifully forwarded to next router increasing the load all the way to destination. Optimal strategy for single user i.e. trying to use as much bandwidth as possible may not be optimal for whole network.

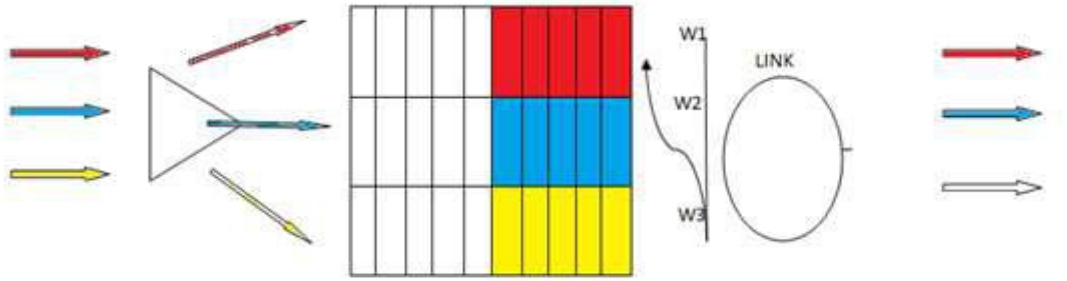

Figure1.3 Weighted Fair Queuing Model

1.3 MDRR (Modified Deficit Round Robin), With MDRR configured as the queuing strategy, non-empty queues in a round-robin fashion. Each time a queue is served, a fixed amount of data is de-queued. The algorithm then services the next queue. When a queue is served, MDRR keeps track of the number of bytes of data that was de-queued in excess of the configured value. In the next pass, when the queue is served again, less data will be de-queued to compensate for the excess data that was served previously served one after another As a result, the average amount of data de queued per queue will be close to the configured value. In addition, MDRR maintains a priority queue that gets served on a preferential basis. MDRR is explained in greater detail in this section. Each queue within MDRR is defined by two variables.

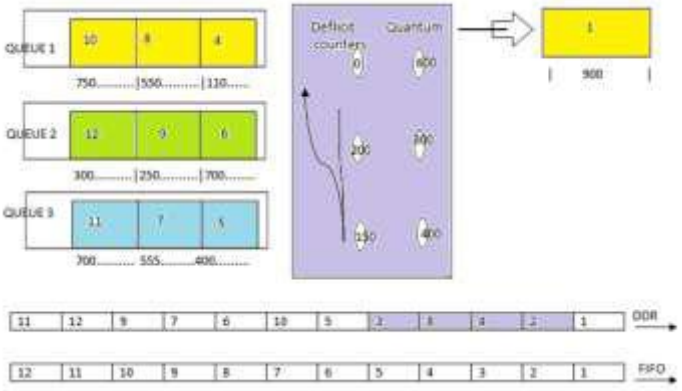

Figure1.4 Modified Deficit Round Robin

1.4 Deficit Weighted Round Robin (DWRR)

Deficit weighted round robin (DWRR) queuing was proposed by M. Shreedhar and G. Varghese in 1995. DWRR is the basis for a class of queue scheduling disciplines that are designed to address the limitations of the WRR and WFQ models.DWRR addresses the limitations of the WRR model by accurately supporting the weighted fair distribution of bandwidth when servicing queues that contain variable-length packets.

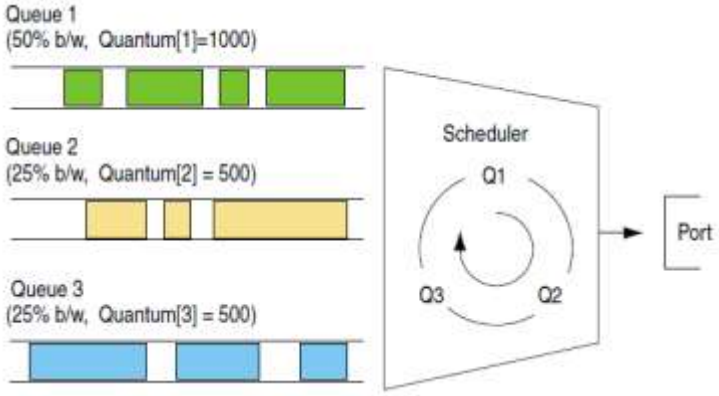

Figure 1.5 Deficit Weighted Round Robin queuing

2 literature survey

[1] Shurman et al (2018)studied two types of queues used in 5G networks: First-in-First-out (FIFO) and Modified Deficit Round-Robin (MDRR). Simulation results demonstrate that MDRR has better performance over FIFO in most metrics, such as end-to-end delay, average Ethernet delay (sec), and receiver utilization and receiver throughput.

[2] Mustafa et al (2018) presented the simulation results of the comparison of three Queuing Mechanisms, Priority Queuing (PQ), weighted Fair Queuing (WFQ) and First in First out (FIFO). This comparison explains that, PQ doesn't need high specification hardware (memory and CPU) but when used it is not fair, because it serves one application and ignore the other application and FIFO mechanism has smaller queuing delay, otherwise PQ has bigger delay.

[3] MeinariniCaturUtami et al (2018) the method of inventory recording of goods used is FIFO, where the goods enter the first then the goods are issued functions that must exist in the system consist of storing and managing all inventory data. The system may provide an automatic serial number for each incoming and outgoing goods recording, recording of the quality of goods, cooperation contracts, demand reports of goods and procurement letters in order to avoid redundancy of data and loss of evidence reporting records. System can provide inventory report of goods that can be accessed dated, monthly or per year.

[4] HemantKaushal et al (2017) the asynchronous FIFO is successfully implemented on FPGA. The FIFO is made parameterized and also additional status flags like underflow "overflow", "near empty" and "near full" are included in the design to make the design safer. The design turns out to be of high speed with maximum frequency146.864 MHz.

[5]WagdyAnis Aziz et al (2017). Six queuing algorithms used to manage congestion: FIFO, PQ, WFQ, MWRR, DWRR, and MDRR. The three most efficient algorithms (MDRR, WFQ, and DWRR) authors re-compared in respect of the delay of Voice packets, jitter, packet loss and throughput. Accordingly to the results, MDRR has the best performance for Voice packets due to a priority parameter.

[6] Mehajabeen Fatima et al (2017) Researchers have calculated the different performance parameters for each algorithm. Researchers are sending the 1000 packets during the 600 sec simulation period so it has been observed that performance parameters are varying according to algorithms. RED achieved the better result in term of the throughput and total packets receive but in term of delay and queue length FIFO shows the better result. AODV protocols also show the better performance with RED queue than DSR.

3 Results

3.1 Database Query Response time:

Time elapsed between sending a Request and Receiving the Response Packet Measured from the Time when the Database Query Application sends a Request to the Server to the time it receives a Response Packet Every Response Packet sent from a Server to a Database Query application is included in the statistic. In this part it is shown the Performance of each queue system with Database Query Response Time.

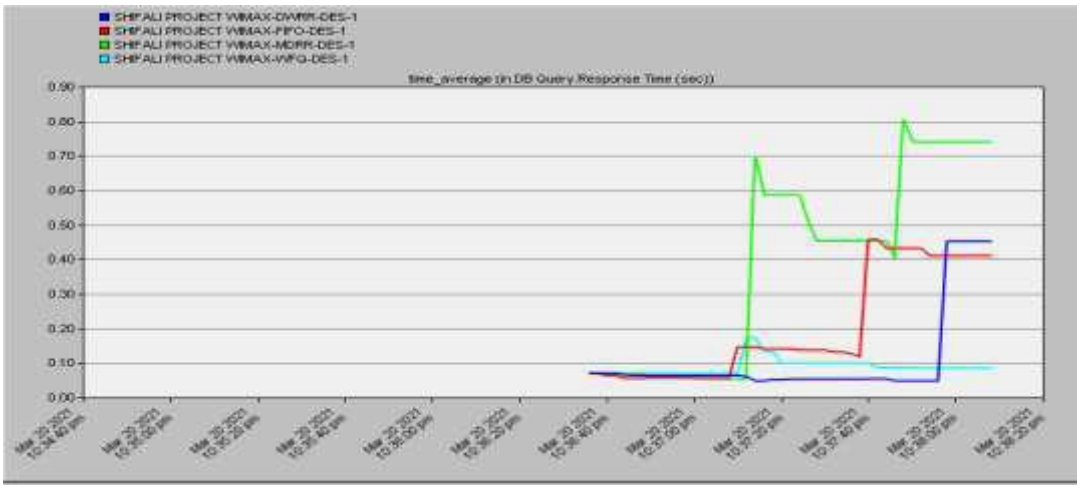

Figure 3. 1 Data Base Query Response Time

According to simulation, in Figure 3.1 it can be seen that Database Query Response time of MDRR is worst that is 0.74 after that DWRR is providing that is 0.45 second, FIFO Response time is 0.41 but all of WFQ Database Query Response time is best that is 0.08 .so in Database Query Response time Performance it can say that Weighted fair queuing is best queue.

3.2 Http Object Response time:

Http Object Response time define as Specifies Response time for each inlined objects from the HTML page.According to simulation, as it can be seen in Fig. 3.2, Http Object Response time metric has been shown in which it can be seen that Http Object Response time metric of DWRR is worst that is 1.04 after that FIFO is providing that is 0.49 second, MDRR Response time is 0.19 but all of the queue Weighted fair queuing is best queue its Http Object Response time is 0.09

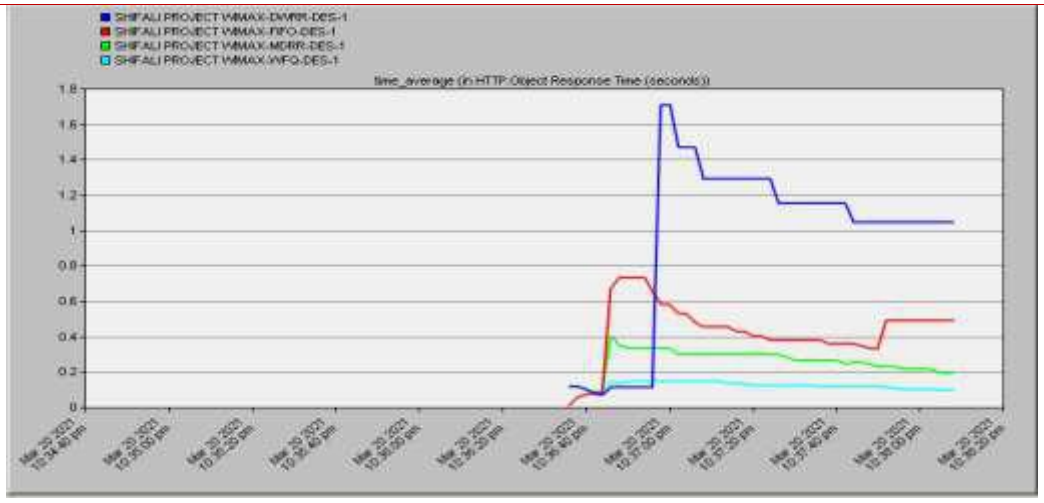

Figure 3.2 Http Object Response time

3.3 Video End to End Delay Variance among end to end delays for video packets .End to End Delay for video packets is measured from the time it is created to the time it is received.

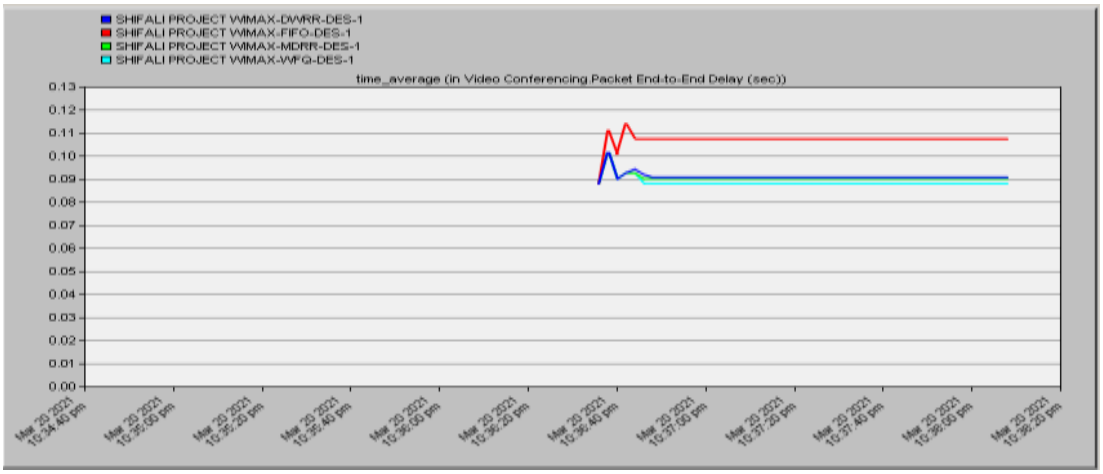

Figure 3.3Video End to End Delay

According to simulation, as it can be seen in Fig. 3.3Video End to End Delay metric has been shown of First-in, First-out (FIFO), Modified Deficit Round Robin(MDRR), Weighted Fair Queuing (WFQ), Deficit Weighted Round Robin (DWRR). in which it can be seen that Video End to End Delayof FIFO is worst that is 0.10 after that MDRR is providing that is 0.09 second, DWRR Response time is 0.09 but all of Queues Weighted Fair Queuing (WFQ), Video End to End Delay is best that is 0.08 .so in Video End to End Delayit can say that Weighted Fair Queuing is best queue.

3.4 Voice Jitter Voice Jitter is define as if two consecutive packets leave the source node with time stamps t1 & t2 and are played back at the destination node at time t3 & t4 ,then jitter =(t4 - t3) – (t2 – t1) Negative Jitter indicates that the time difference between the packets at the destination node was less than that at source node.

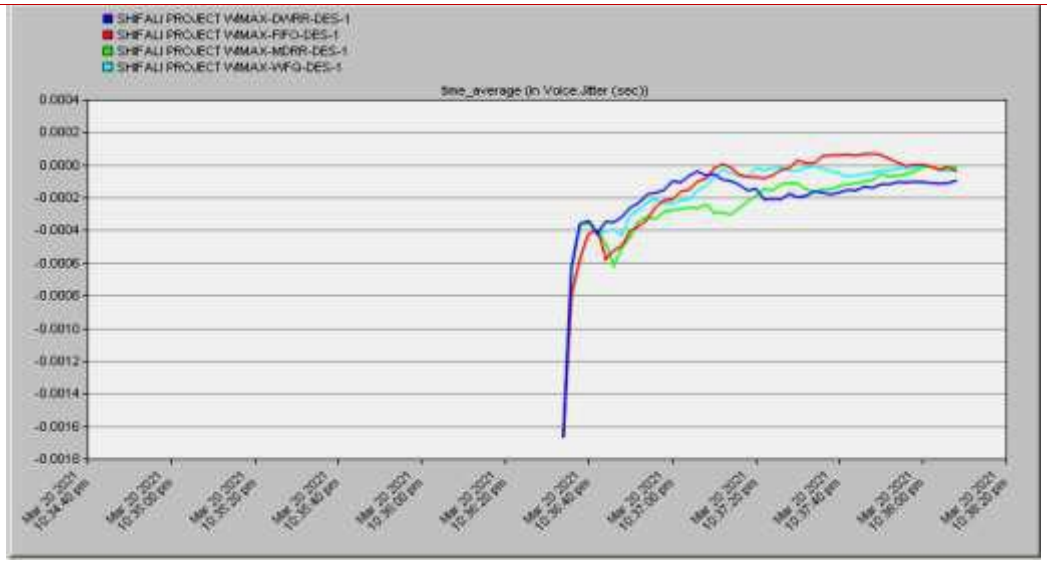

Figure 3.4Voice Jitter

According to simulation, as it can be seen in Fig. 3.4Voice jitter metric has been shown First-in, First-out (FIFO), Modified Deficit Round Robin(MDRR), Weighted Fair Queuing (WFQ), and Deficit Weighted Round Robin (DWRR). In which all queues jitter value is almost same but in terms of mathematics Deficit Weighted Round Robin (DWRR) delay is little bit fine among of all.

3.5 Voice Packet Delay

Delay is caused when packets of data (Voice) take more time than expected to reach their destination. This causes some disruption is the Voice quality.

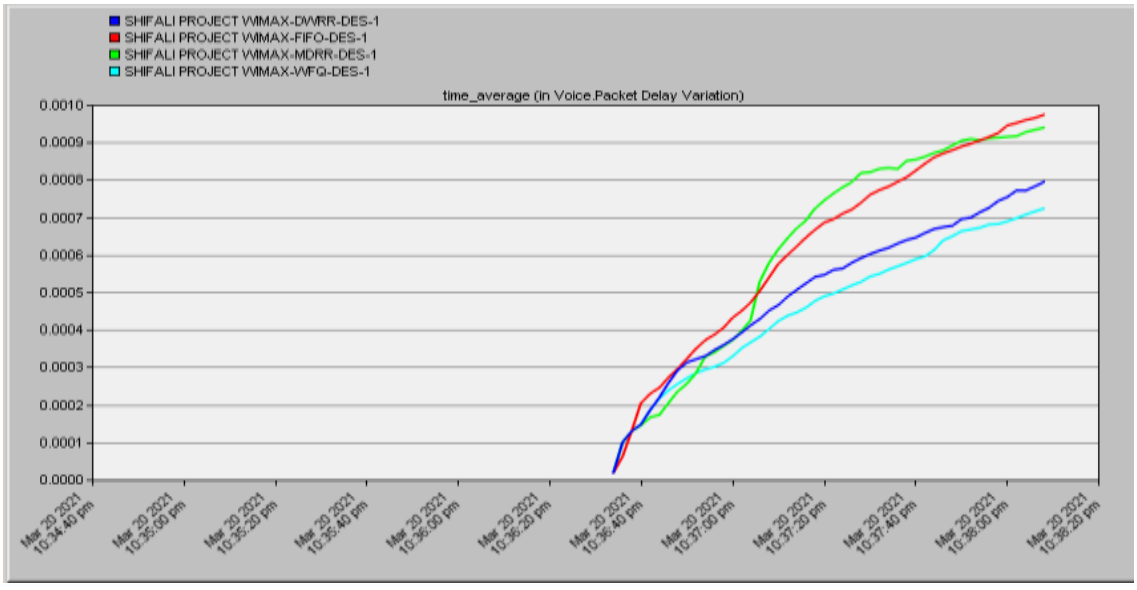

Figure 3.5 Voice Packet Delay

According to simulation, as it can be seen in Fig. 3.5 Voice Packet Delay metric has been shown First-in, First-out (FIFO), Modified Deficit Round Robin **(**MDRR), Weighted Fair Queuing (WFQ), Deficit Weighted Round Robin(DWRR). in which it can be seen that Voice Packet Delay of FIFO is worst that is 0.00093 after that

MDRR is providing 0.00093 ,DWRR Response time is 0.00079 but all ofWeighted Fair QueuingVoice Packet Delay is best that is 0.00072 .so in Voice Packet Delay it can say that Weighted Fair Queuingis best queue.

3.6 Voice End to End Delay: Avearge number of Packets per second submitted to the transport layers by all Voice application in the network.

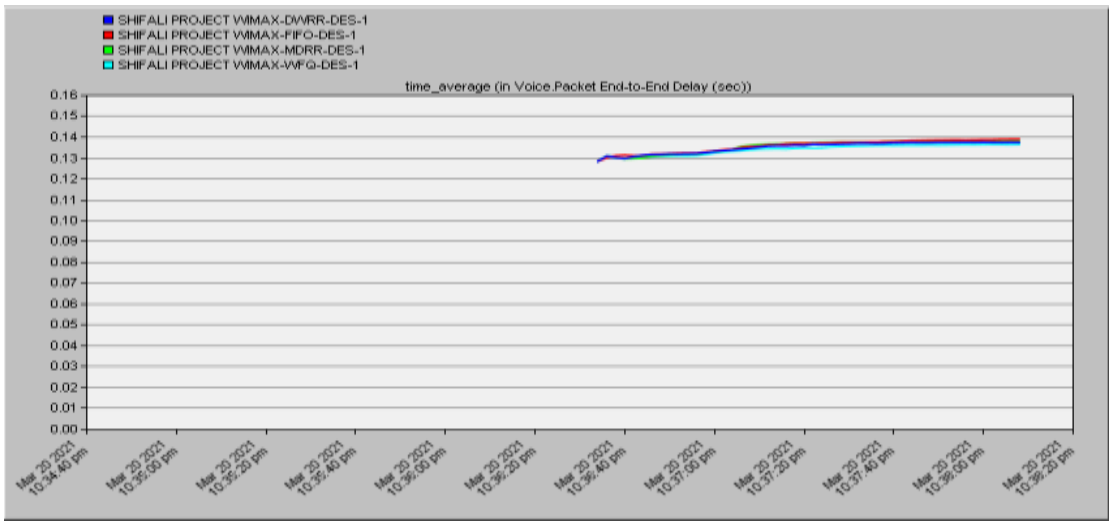

Figure 3.6Voice End to End Delay

According to simulation, as it can be seen in Fig. 3.6Voice End to End Delay metric has been shown First-in, First-out (FIFO), Modified Deficit Round Robin **(**MDRR), Weighted Fair Queuing (WFQ), and Deficit Weighted Round Robin (DWRR). in which it can be seen Voice End to End Delay of FIFO is worst that is 0.1387 after that MDRR is providing that is 0.1378 second, DWRR Response time is 0.1373 but all ofWeighted Fair Queuing (WFQ) Voice Packet Delay is best that is 0.1363 .so in Voice End to End Delay it can say that Weighted Fair Queuing (WFQ)

BRIEF CHART OF RESULTS

Metric	**FIFO**	**MDRR**	**DWRR**	**WFQ**
Database	0.41	0.74	0.45	0.08
Http object	0.49	0.19	1.04	0.09
Video End to End delay	0.10	0.09	0.09	0.08
Voice Jitter	-0.000042	-0.000019	-0.000097	-0.000024
Voice Packet delay	0.00097	0.00093	0.00079	0.00072
Voice End to End delay	0.1387	0.1378	0.1373	0.1363

4 Conclusions & Future Work

In this Paper we concluded mainly two types of studies; one is analytical and second is Practical which is based on OPNET Simulator. Analytic Study concluded the behavior of each Queue System like FIFO, MDRR WFQ & DWRR. All the Network Performance has depended on its Queue System .Each different Queue System has different processing Mechanism according to their environmental scenarios. From Simulator aspects we concluded that which is major factor that can affect the performance of Network that is Network size. Some Protocol may be best in small or medium but may not be best in large network. some may be provide best results on medium or large but may be give worst response on small network .so simulator point of view network size can play important role in the performance of Routing Protocol. In this Paper , we have presented different WIMAX Network which are based on different Queue System such as FIFO, MDRR WFQ & DWRR,To Obtain the Performance of WIMAX Network different setup of some related devices has been configured. To fulfill the objectives of this Paper we have created four different scenarios with WIMAX nodes, each for different Network .so on the behalf of each different Network four different Network has been configured. Comparative analysis has been done respectively with FIFO, MDRR WFQ & DWRR for real time applications. Performance has been measured on the basis of some parameters that aimed to figure out the effects of routing protocols. Respective Performance Metrics Database query Response Time, Http Object Response Time, and Video End to End Delay, Jitter, Voice Packet Delay, and Voice End to End Delay. The simulation Run time processing Time is set to 200 seconds for each Network. To check the Performance each Network we have taken different metrics. We have concluded that WFQ is best queue according to simulator results. In future, research work can be done on the Another's Queue System and some others Performance metrics also can be taken.

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