Volume 3, Issue 8, August 2013 ISSN: 2277 128X

International Journal of Advanced Research in Computer Science and Software Engineering

Research Paper

Available online at: www.ijarcsse.com

Comparative Study of QoS Scheduling Algorithms in WiMAX

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Abstract: With the increasing demand of wireless access to the network the demand for good quality network has also increased. This demand is increased by the bandwidth intensive applications like audio, video. So this increased demand for good quality network, has further increased the demand of designing scheduling algorithms which provides high throughput and minimum delay and load. In this work, a comparative study of different scheduling algorithms such as modified round robin, modified weighted round robin, enhanced modified deficit round robin and priority round robin was carried out. The results are analyzed and the performance of each scheduler is evaluated. The simulation environment is created and carried by using OPNET 14.0.

Keywords-IEEE 802.16, WiMAX scheduling, OPNET, QoS.

I. Introduction

WiMAX stands for Worldwide interoperability for Microwave Access. It is one of the most emerging technologies for Broadband Wireless Access (BWA) that provides wireless transmission of data using a variety of transmission modes, like by using point-to-multipoint access [1]. Different types of applications and services can be used in WiMAX networks and for that MAC layer is designed. There are two operational modes: mesh and point-to-multipoint (PMP). In the former mode, all the subscriber stations (SS) are allowed to communicate to each other and to the base stations (BS). In the PMP mode, the SSs can only communicate through the BS. WiMAX (Broadband wireless networks) can be categorized into a single-hop and multi-hop network. In single-hop network, the Base Station (BS) makes and delivers decisions to all the nodes such as Subscriber Stations (SSs) in its cell. On the other hand, in a cellular multi-hop network, some SSs are not connected to base station directly. For example, while transferring data, building could block the path from the BS to the SS. In such type of networks, a relay mechanism is required that will relay information to other SSs that are not in direct contact with the BS. Two or more wireless hops to transfer information from source to the destination are used in multi hop networks [2] [3].

IEEE 802.16 is specialized in point-to- multi point broadband wireless access. WiMAX is used as broadband wireless access at high speed and low cost, which is easy to deploy. And it also provides a scalable solution for extension of a fiber-optic backbone. WiMAX provides coverage of over 5 miles with the bandwidth of up to 70 mbps [2].

There are many bandwidth allocation algorithms that have been designed for the efficient utilization of the scarce radio resources [4]. It is very important to ensure that, diversifying requirements of different applications are satisfied in the best possible way by providing outstanding services to the end user [5]. But with the increasing WiMAX users the efficient usage of resources will become difficult to achieve. So quality of service is becoming an important issue to be achieved to differentiate oneself from other competing technologies. Different classes of Quality of Services (QoS) includes different services like data, voice and video services. Scheduling has become one of the most challenging issues these days because scheduling is needed when available network resources are required to be distributed. For this there is a need to construct different scheduling algorithms in order to improve the network utilization and also to increase the network throughput, and also aims to minimize the end-to-end delay [6]. Different scheduling classes like Unsolicited grant services (UGS), Real-time polling services (rtPS), Non- real-time polling service rate (nrtPS), Extended real-time polling service (ertPS) and Best-Effort services (BE) are supported by WiMAX [3]. The fairness and efficiency in meeting the QoS requirement is ensured by these service classes. There are many scheduling algorithms in WiMAX which work in round robin fashion. In this paper the comparative study of different round robin algorithm is done and the results are analyzed. The comparison of these scheduling algorithm is done on the basis of their performance and ability to support the different service classes.

II Quality of Service

QoS guarantees the ability of a network to deliver predictable results. QoS manage network traffic to measure bandwidth. Changing network conditions such as increasing/decreasing congestion, availability of bandwidth and prioritize traffic is detected. Required bit rate, delay, jitter, packet dropping probability and bit error rate is guaranteed [7]. The demand for new features has increased with the application of 802.16 standards. So support of QoS is needed for that. QoS intend to provide

improved services to selected network traffic. It provides services to underlying technologies including wired-based technologies.

III Scheduling Algorithms

The scheduling algorithms that has been compared are:

1. **Modified Round robin**-There are few drawbacks of simple round robin algorithm like large waiting time, more context switches. In modified version of round robin small processor is used so as to reduce the burden of main processor. So Modified Round Robin solves this problem by providing dynamic approach. In Modified Round Robin the operating systems adjusts the time quantum according to the burst time of the set of waiting processes already in the ready queue [8].
2. **Enhanced Modified Deficit Round Robin**- Modified deficit round robin is the modification of deficit round robin. The delay is reduced by modified round robin as transmission is allowed each time the queue is visited. It efficiently uses bandwidth by allocating bandwidth in a priority manner to delay sensitive packets. It is the mixture of MDRR and EDP [9].
3. **Modified Weighted Round Robin-** It is modified version of MWRR. It Perform better in real time applications traffic. In MWRR, retrieve function checks weight assignments before running MWRR scheduling technique [10].
4. **Priority round robin**- By using priority round robin overall errors are reduced by enforcing priority which is based on a freely definable error metric. It retains the output sensitivity and starvation free performance of RR. Priorities are enforced by this algorithm while retaining the output sensitivity and starvation-free performance of RR [11].

IV Simulation Results

The simulation environment has been created to study the performance of various scheduling algorithms. The scenario consisting of 8 mobile stations and 1 base station in WiMAX Network has been created in circular mode using OPNET 14.0 as shown in Figure 1. The parameters are configured for the mobile nodes, base station and WiMAX Node and the detailed pictorial representation of configuration is shown in Figure 2, Figure 3 and Figure 4 respectively. Table 1 shows the base station parameters and WiMAX parameters. Time division duplexing is used as the duplexing technique. Bandwidth and Base frequency are 20 Mhz and 5 Ghz respectively. Different experiments were carried out with varying simulation parameters. Three applications which has been taken are FTP, email and remote login. Along x axis we have Simulation time for all the graphs [12].

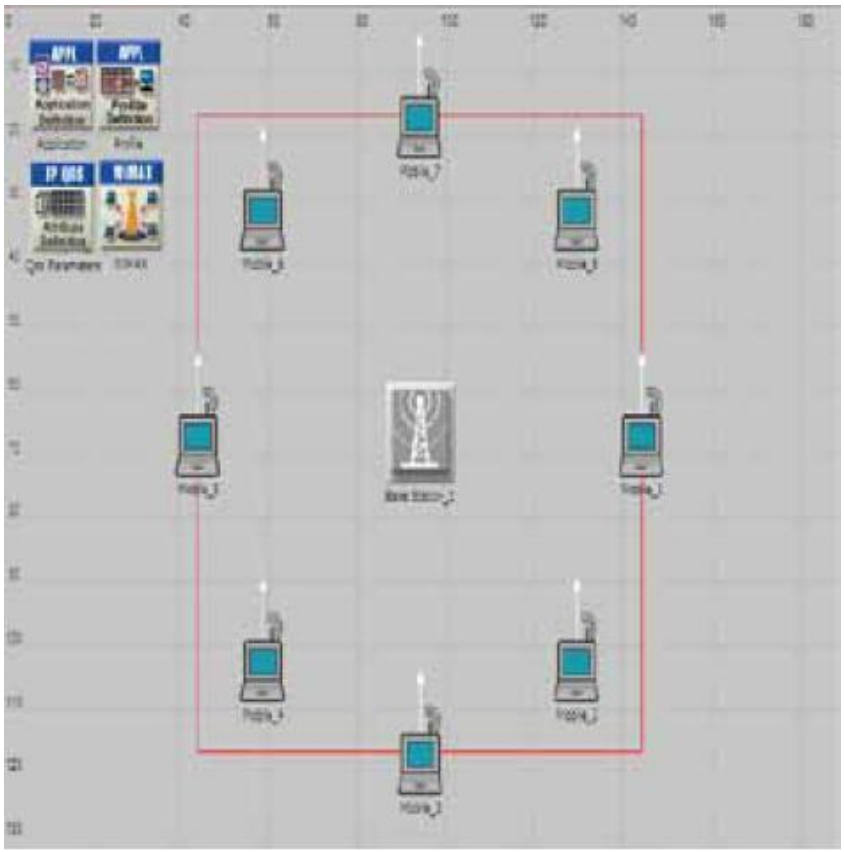

Figure-1 8 nodes in circular mode

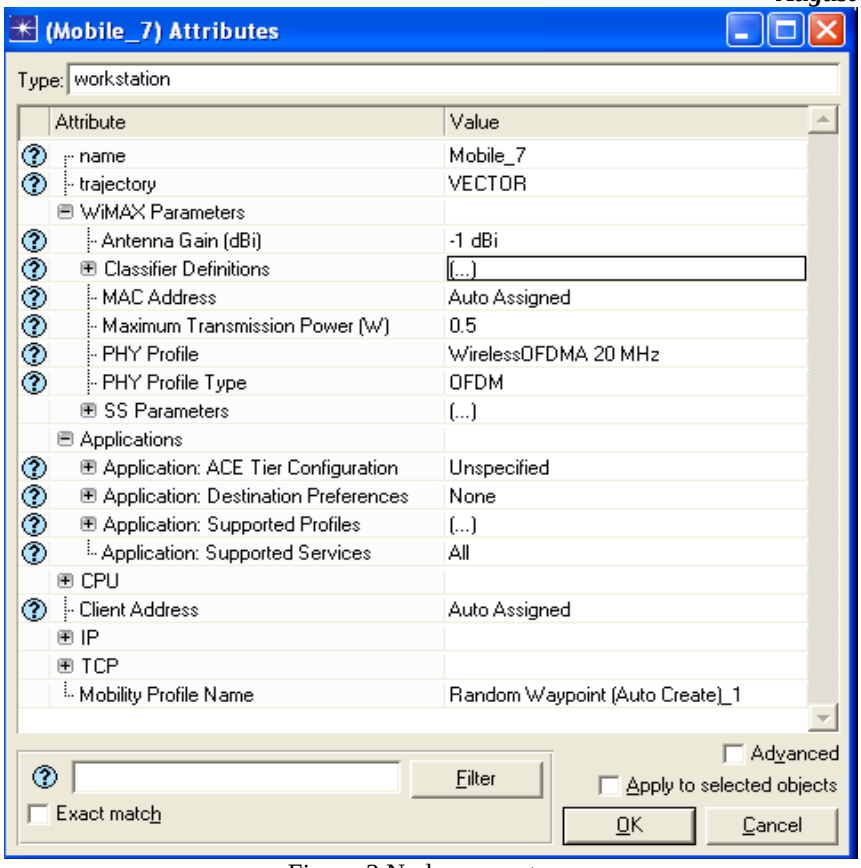

Figure-2 Node parameters

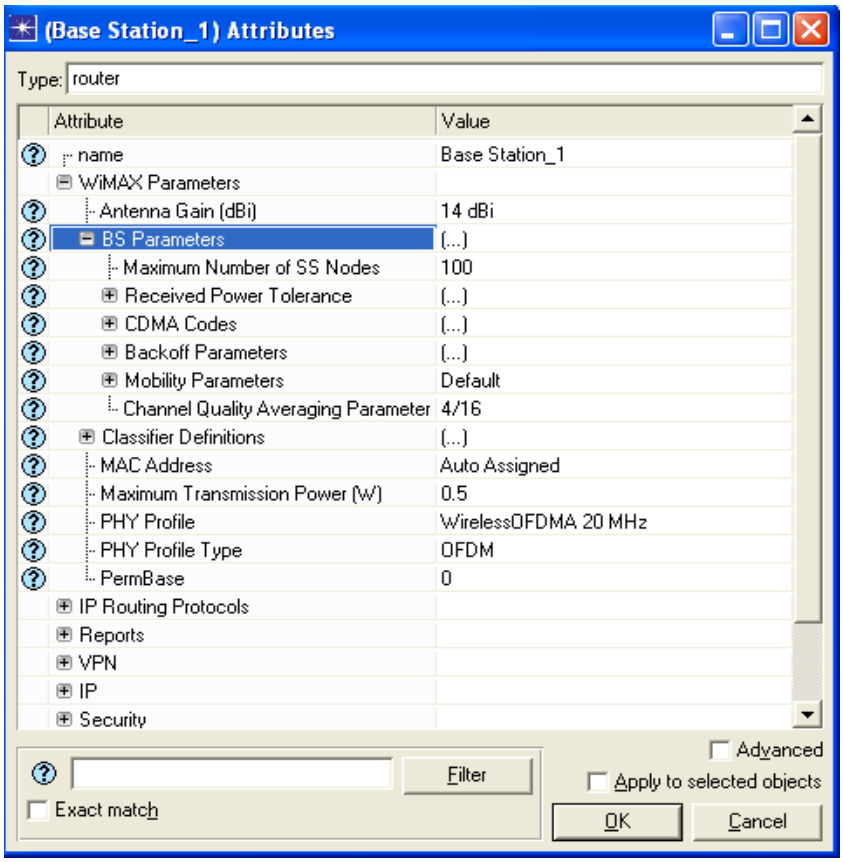

Figure-3 Base station parameters

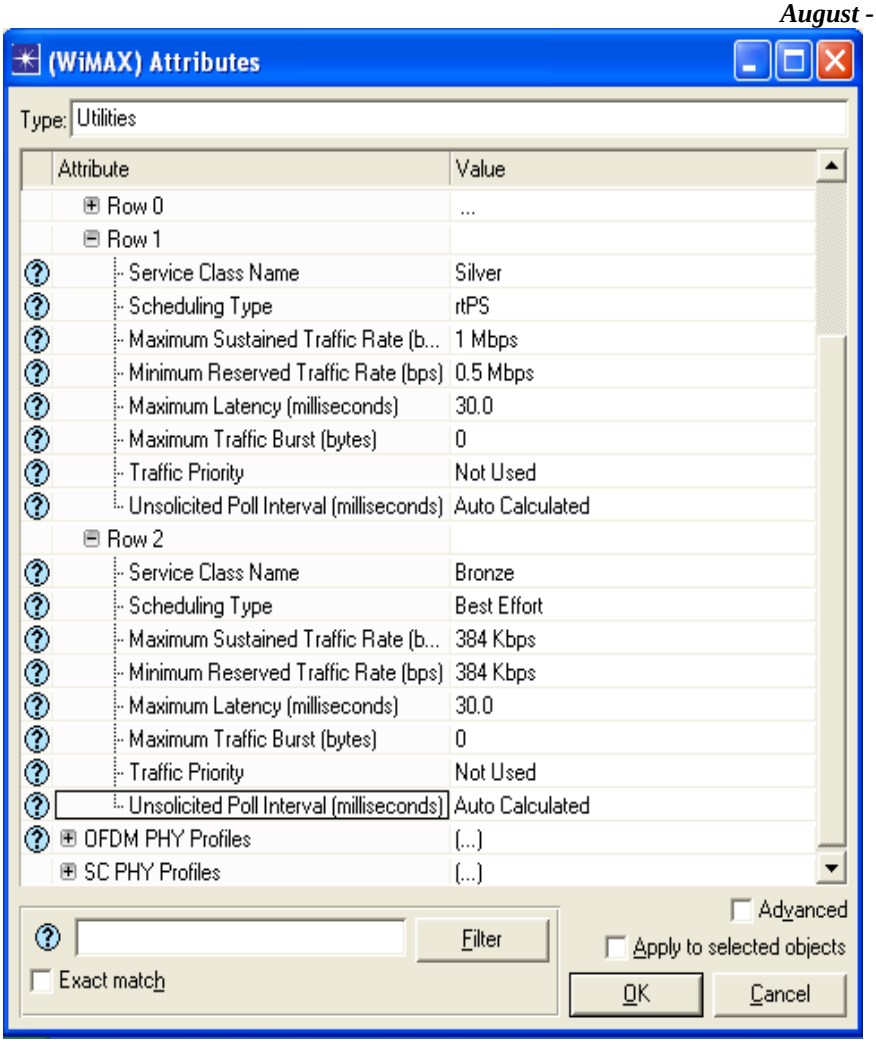

Figure-4 WiMAX attributes

Table- 1 Simulation parameters

Base station parameters	PHY profile=Wireless OFDMA 20 MHz PHY profile type=OFDM Antenna type=omni Antenna gain=15dbi
WiMAX attributes	Frame duration(millisecond)=5 Duplexing technique=TDD Base frequency=5 GHz Bandwidth= 20 MHz Frame duration (milliseconds)= 5 Maximum latency (milliseconds)=30

Figure 5 shows that, MRR has highest delay. On the other hand PRR has lowest delay. On the other hand MWRR and enhanced MDRR has delay value in between MRR and PRR. But initially the delay for enhanced MRR, MWRR, PRR was constant.

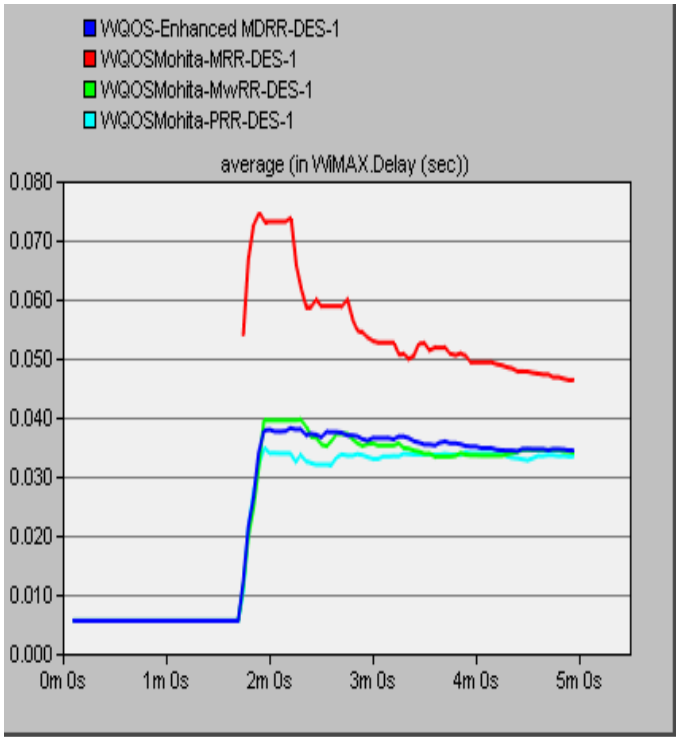

Figure-5 average WiMAX delay

In Figure 6 results WiMAX load (packets/sec) has been presented. The results indicate that the Enhanced MDRR has highest load and MRR has lowest load. Whereas MWRR and PRR has load in-between MRR and Enhanced MDRR. Previously there was no load till 1.7 min and after that there is sudden increase in load at simulation time1.7 min

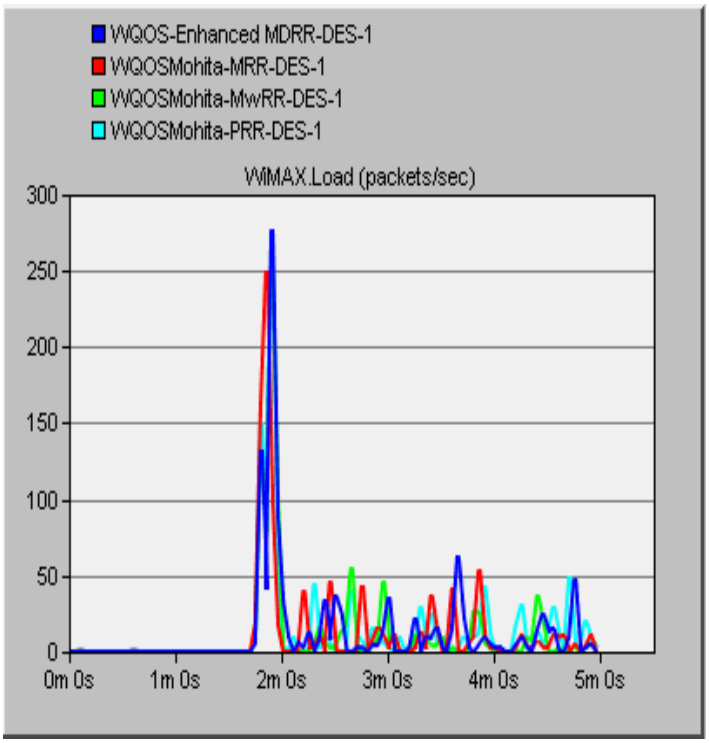

Figure-6 WiMAX load

In Figure 7 WiMAX throughput is shown. In this PRR records the highest throughput as compare to MRR, MWRR and enhanced MDRR. Enhanced MDRR records throughput, slightly less than PRR. And out of these three scheduling algorithm MWRR has recorded lowest throughput. Up to 1.7 minute throughput was constant for MRR, MWRR and PRR but the throughput for enhanced MDRR is not exactly constant

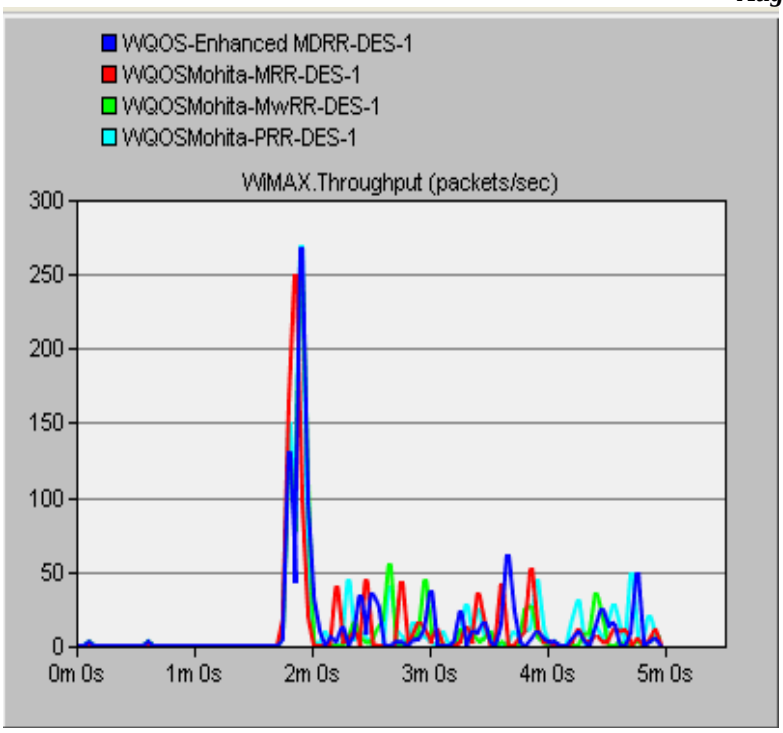

Figure-7 WiMAX throughput

In Figure 8 traffic received for email is shown. The traffic received is in terms of packets/sec. It is evident that MRR outperform others receiving the highest traffic. But until 1.7 minute of simulation time no traffic was received for all the scheduling algorithms (enhanced MDRR, MWRR, MRR, PRR).

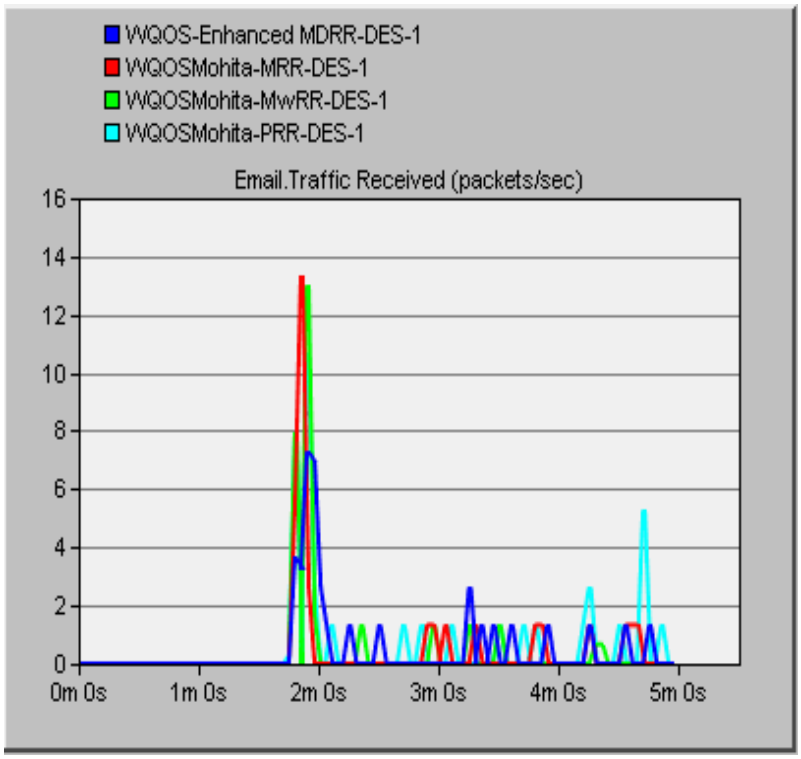

Figure-8 traffic received-Email (BE)

Figure 9 reveals the traffic received by using application FTP. The highest traffic is recorded in PRR and MWRR and the lowest traffic is recorded in Enhanced MDRR. After that the received traffic starts decreasing for all scheduling algorithms. But previously there was no traffic received till 1.7 min.

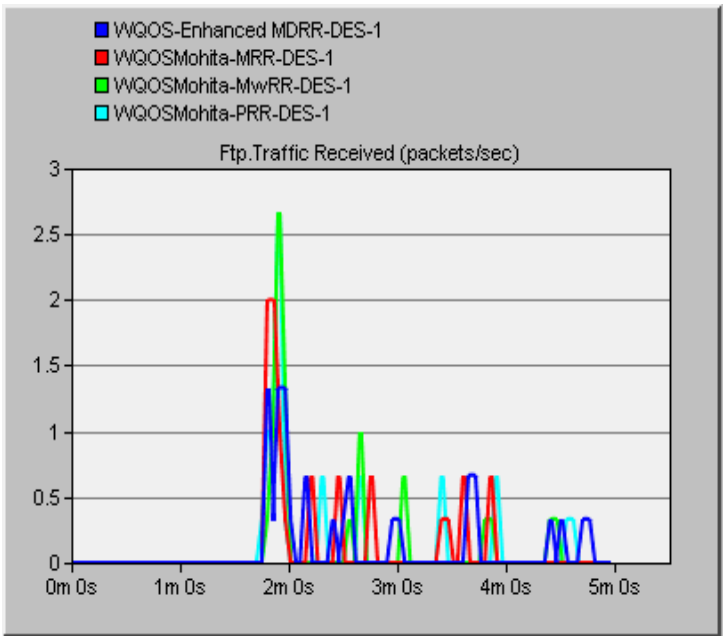

Figure-9 traffic received-FTP (nrtPS)

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In Figure-10 result for traffic received for remote login has been presented. The traffic is in terms of packets/second. It is clearly reveled that PRR has received the highest traffic among other scheduling algorithms (enhanced MDRR, MWRR, PRR).

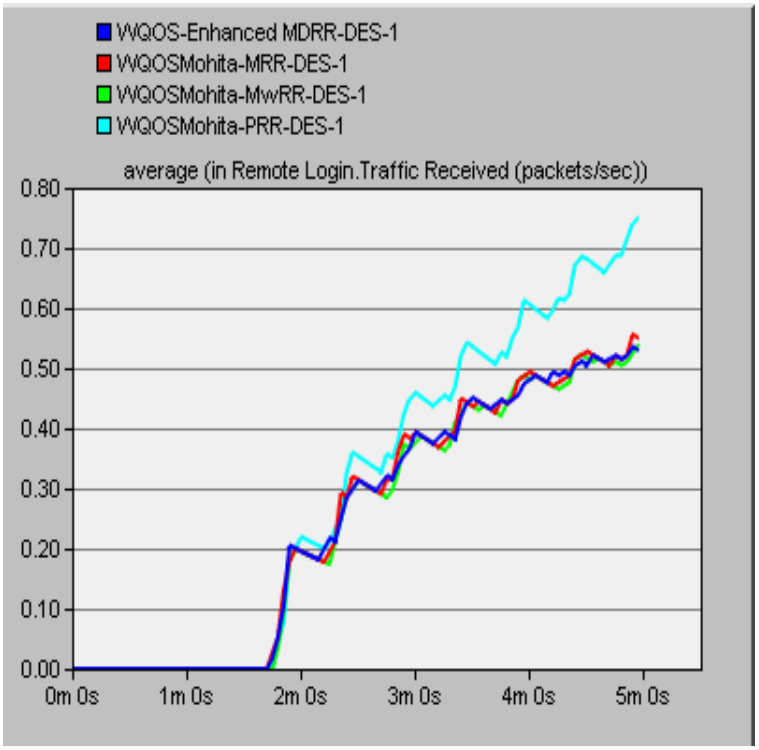

Figure- 10 average traffic received-remote login (rtPS)

V. Conclusion and future work

In this paper, the comparison of different scheduling algorithms such as modified round robin, modified weighted round robin, enhanced modified deficit round robin, priority round robin has been carried. It is concluded that PRR has highest throughput and less delay. MRR has lowest network load. The traffic received for email was highest for MRR. But PRR outperform others in terms of traffic received in remote login and FTP. For future work Comparison of these scheduling algorithm can be carried out on two or more different simulation tools. Compare these scheduling algorithms by applying them on all the service classes.

Acknowlegments

I wish to acknowledge the help and encouragement given by Amardeep Kaur to me . She had played an instrumental role during the whole research process. She has taken my research work to a new heights by suggesting changes to make my work more presentable. She assisted me at every step. Her wide knowledge and logical way of thinking have been benefited me in a great way. I would like to appreciate her for the assistance she has provided to me, from the bottom of my heart.

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