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Performance Analysis of Different Scheduling Algorithms in WiMAX Network Quality of Services

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Abstract— *The scheduling algorithms play a vital role in deciding the Quality of Service (QoS) provided by the WiMAX Network. In this paper, the performance of various scheduling algorithms for WiMAX network is investigated. The QoS of WiMAX in terms of total unicast messages received, average unicast delay and jitter; total packets en-queued and de-queued, dropped; average queue length and queue time for various scheduling algorithms are compared. The simulation results show that, performance of Weighted Fair Queuing Scheduler (WFQ) and Differentiated Services are better compared over other scheduling algorithms.*

Keywords— Differentiated Services, Quality of Service, Weighted Fair Queuing Scheduler, WiMAX network.

I. INTRODUCTION

The services provided by the wireless network depend on the Quality of Service (QoS) which decides the competence among the different technologies. The WiMAX network is the backbone for Broadband Wireless Access (BWA) technology used to offer various services like VoIP, MPEG, FTP and data services [1-3]. WiMAX architecture and standards are discussed in [4]. The Qos architecture of WiMAX is given in [5].

The various QoS services are: (i) Best-effort (ii) Differentiated and (ii) Guaranteed services [6]. Among these first one provides connectivity without assurance, middle one provides priority for the traffic depending on the application. Third one provides reservation of resources for few.

For prioritizing WiMAX have five different categories of services [7-9]. They are: (i) Unsolicited Grant Service (UGS) (ii) Extended Real-time Polling Service (ertPS) (iii) Real Time Polling Service (rtPS) (iv) Non-real-time Polling Service (nrtPS) and (v)Best Effort (BE). The QoS of these services are examined for different environments in [7] and its effectiveness in residential and enterprises are examined in [10]. Resource allocation for these services dynamically is discussed in [11].

The scheduling algorithms are used to avoid congestion control in various services. Few such scheduling algorithms [12] are First in First out (FIFO), Priority Queuing (PQ), Round Robin (RR), weighted RR and Weighted Fair Queuing (WFQ) etc. FIFO not offer any priority as in PQ and PQ is not adaptive to real traffic. WFQ provides different weights as per bandwidth.

Traffic scheduling and in-network QoS decency using WFQ, RR is examined in [13] and bandwidth allocation using various scheduling algorithms are analyzed [14]. Aymen Belghith et. al proposed mSIR scheduler to improve the rtPS performance [15]. The QoS performance for Internet Protocol Television application is investigated in [16].

In this paper, various scheduling algorithms QoS are analyzed for WiMAX 802.16 standards.

II. SCHEDULING ALGORITHMS

In this paper, the various scheduling algorithms are considered. They are: RR, WFQ, Strict Priority (SP), Self- Clocked Fair Queuing (SCFQ), and Differentiated Services (DS).

In RR, serves one packet to one by one until all packets are exhausted. WFQ has assign weights according to bandwidth and dynamic packet length. In SCFQ, order of the packet scheduled is decided by virtually, during the process. In SP, it serves from highest priority to lowest priority.

III. RESULTS

The WiMAX network QoS performance is measured in terms of total unicast messages received, its delay, throughput, jitter; total packets enqueued, dequeued, dropped, average queue length and average time in queue. The Qualnet Simulator is used for simulation. The scheduling algorithms used IEEE 802.16 standards for different services in WiMAX like best effort, nrtPS, rtPs, ertPS and UGS. The simulation time of 20s is considered.

The total unicast messages received for various scheduling algorithms are shown in Fig. 1. Among all, the WFQ has highest and DS has next highest total unicast messages received messages.

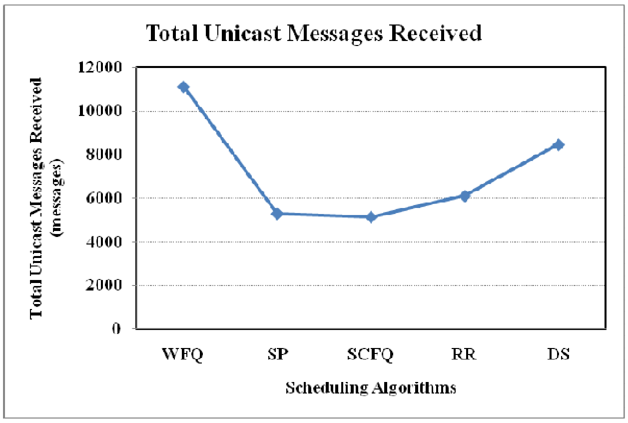

Fig. 1: Total Unicast Messages Received

The total average unicast end-to-end delay for various scheduling algorithms is shown in Fig. 2. Among all, the DS has lowest and WFQ has next lowest total unicast end-to-end delay.

The total unicast received throughput for various scheduling algorithms is shown in Fig. 3. Among all, the WFQ and DS has good throughput. The average unicast jitter for various scheduling algorithms is shown in Fig. 4. Among all, the DS has very less, RR has less, and WFQ have moderate jitter.

The queue length also decides the QoS performance. The total packets enqueued and dequeued for various scheduling algorithms are shown in Fig. 5 and Fig. 6. The enqueue and dequeue lengths of DS are very less and WFQ are less compared to all.

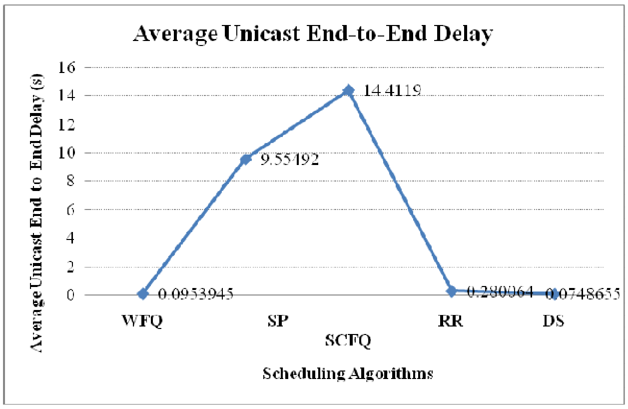

Fig. 2: Average Unicast End-to-End delay

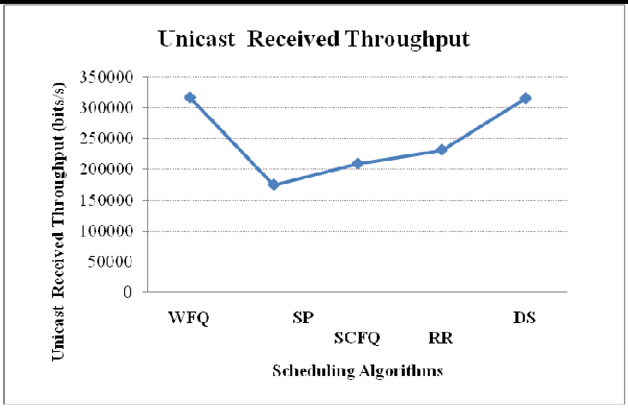

Fig. 3: Unicast Received Throughput

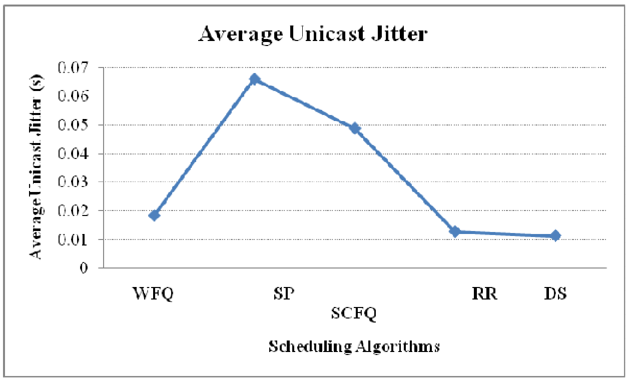

Fig. 4: Average Unicast Jitter

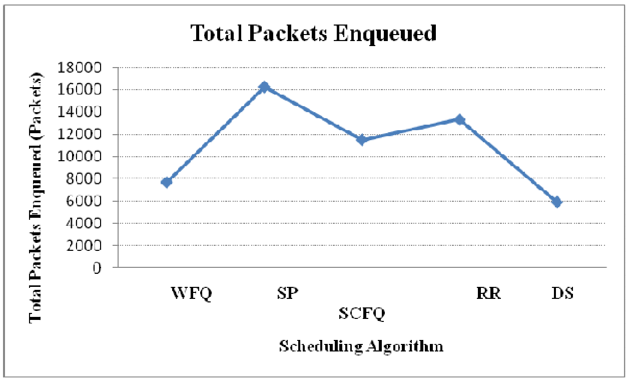

Fig. 5: Total Packets Enqueued

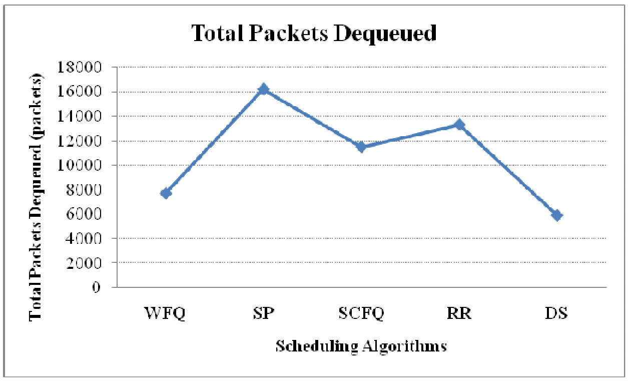

Fig. 6: Total Packets Dequeued

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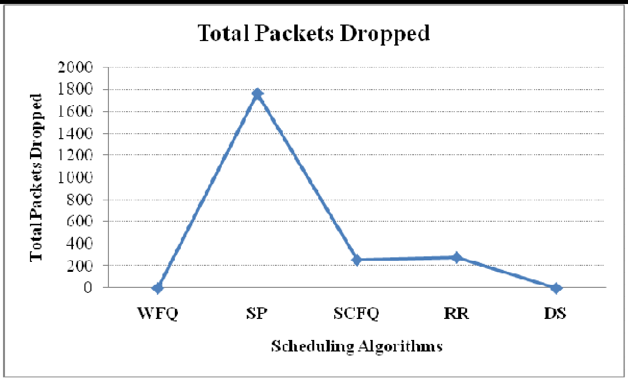

Fig. 7: Total Packets Dropped

The total packets dropped are less in WFQ and DS as shown, in Fig. 7. Average queue length in DS has very less and WFQ has less compared to all scheduling schemes, as shown, in Fig. 8. Average time in queue is very less for SP, less in DS and moderate in RR, as shown, in Fig. 9.

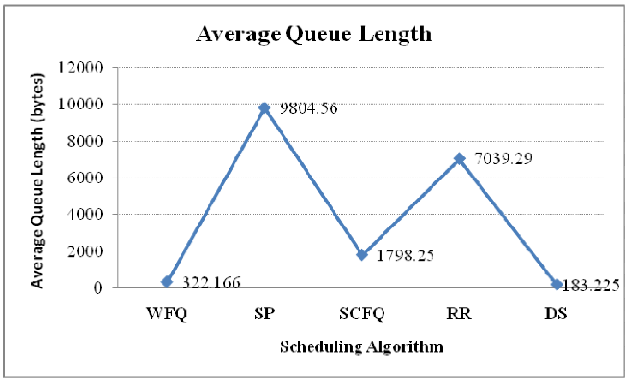

Fig. 8: Average Queue Length

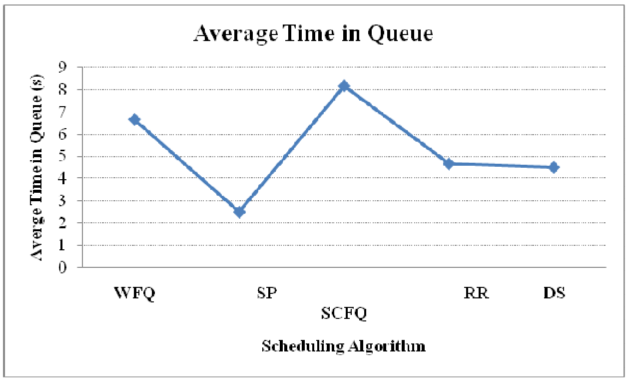

Fig. 9: Average Time in Queue

IV. CONCLUSION

The QoS performance of WiMAX for various scheduling algorithms is compared. Among all, the Differentiated Service scheduling is outperforming. Performance of Weighted Fair Queuing Scheduling is also good.

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