Comparative Study of Various Scheduling Schemes of Wimax

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Abstract
Wireless Man or WiMAX, where WiMAX stands on Worldwide Interoperability for Microwave Access, is one of the latest technologies in the Wire-Less World. WiMAX networks incorporate several qualities of service (QoS) mechanisms at the Media Access Control (MAC) level for guaranteed services for data, voice and video. In the current paper various scheduling schemes are compared on various traffic. Various schemes are proposed in this paper called MWRR, DWRR, PFS and MPQ. In the comparison of the defined above MPQ and PFS show he best results.

Keywords
MWRR, DWRR, PFS, MPQ

1. Introduction

IEEE 802.16 a set of telecommunications technology standards aims at providing wireless access over long distances in a variety of ways - from point-to-point links to full mobile cellular type access. IEEE 802.16e also called Wireless MAN covers a metropolitan area of several kilometers. WiMAX networks, a connection-oriented technology does not include multimedia data, because IEEE 802.16e is not present in current profiles of the WiMAX forum [1].It is estimated that a WiMAX base station can provide broadband wireless access in range up to 30 miles (50 km) for fixed stations and 3 to 10 miles (5 to 15 km) for mobile stations with a maximum data rate of up to 70 Mbps [1] & [2] compared to 802.11a with 54 Mbps up to several hundred meters, EDGE (Enhanced Data Rates for Global Evolution) with 384 kbps to a few km, or CDMA2000 (Code-Division Multiple Access 2000) with 2 Mbps for a few km. Since 2001, a number of variants of these standards have been issued and are still being developed. Like other standards, the specifications also constitute several competing proposals and contain many other features and mechanisms. The Worldwide Interoperability for Microwave Access Forum or WiMAX Forum [2] is a group of 400+ networking equipment vendors, service providers, component manufacturers and users who will decide which of the numerous options that are allowed in the IEEE 802.16 e standards should be implemented so that equipment from various vendors will inter-operate the fundamental requirements of next generation OFDMA based wireless mobile communication systems which consist on the cross-layer scheduling and resource allocation mechanism. There are several new issues raised due to the interference between the available accesses as the growth of network access technologies increase.

2. QOS Classes

WiMAX standard defines 5 service classes to support its wide range of applications as endorsed by IEEE 802.16. Unsolicited grant services (UGS): This class of service is designed to support fixed-sized data packets at a constant bit rate (CBR) such as E1/T1 lines that can sustain real-time data stream applications. This service provides guaranteed throughput, latency and jitter to the necessary levels as TDM services. UGS is used mainly to support Constant Bit Rate (CBR) services found in voice applications such as voice over IP [3,4,5,6].

Real-time Polling Services (RTPS): This class of service is designed to support real-time service flow that generates variable-sized data packets on a periodic interval with a guaranteed minimum rate and guaranteed delay. The mandatory service flow parameters that define this service are inclusive of minimum reserved traffic rate, maximum sustained traffic rate, maximum latency and request/transmission policy. RTPS is used extensively in MPEG video conferencing and streaming [3, 4, 5, 6].

Non-real-time Polling Service ((NRTPS)): This class of service is designed for non-real-time traffic with no delay guaranteed. The delay tolerant data stream consists of variable-sized data packets. The applications provided by this service are time-insensitive and a minimum amount of bandwidth. This service is especially suitable for critical data application such as in File Transfer Protocol (FTP) [3, 4, 5, 6]

Extended real-time Polling Service ((ERTPS)): This class of service provides real-time applications which generate variable-sized data packets periodically that require guaranteed data rate and delay with silence suppression. This service is only defined in IEEE 802.16e- 2005. During the silent periods, no traffic is sent and no bandwidth is allocated. However, there is a need to have a BS poll during the MS to determine the end of the silent periods. (ERTPS) is featured in VoIP with silence suppression [3,4,5,6,7].

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Best-Effort Services (BE): This class of service provides support for data streams whereby no minimum service-level guarantee is required. The mandatory service flow parameters that define this service include maximum sustained traffic rate, traffic priority and request/transmission policy. BE supports data streams found in Hypertext Transport Protocol (HTTP) and electronic mail (e-mail) [3, 4, 5, 6].

3. Scheduling Algorithm

Scheduling algorithms are implemented at both the BS and SSs. In this paper the scheduling algorithms are defined in intra class schedulers and a scheduler at the SS is required to distribute the bandwidth allocation from the BS among its connections. A scheduling algorithm for the uplink traffic is faces challenges that are not faced by an algorithm for the downlink traffic. An uplink scheduling algorithm does not have all the information about the SSs such as the queue size. An uplink algorithm at the BS has to coordinate its decision with all the SSs where as a downlink algorithm is only concerned in communicating the decision locally to the BS. Figure 2 shows the taxonomy of the scheduling algorithms. Based on the comprehensive survey [8], the scheduling algorithms are classified into 3 categories:

Homogenous scheduling algorithm
Hybrid scheduling algorithm
Opportunistic scheduling algorithm

In Homogenous scheduling algorithms individual algorithms are designed and implemented. Algorithms in this category do not address the issue of link channel quality. In Hybrid scheduling algorithms they are designed with two or more homogenous schedulers to form a hybrid scheduler and these legacy scheduling algorithms in an attempt to satisfy QoS requirements of the four scheduling services. An important aspect of algorithms in this category is the overall allocation of bandwidth among the scheduling services. In Opportunistic scheduling algorithms primary focus is on exploiting the variability in channel conditions in WiMAX.

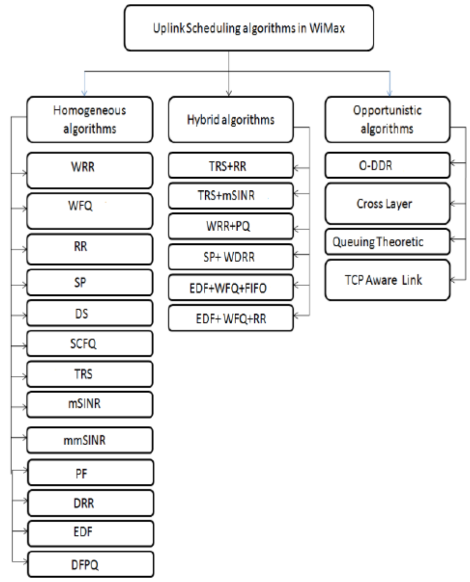

Fig 1: Taxonomy of Scheduling Algorithms

A simplified diagram of the scheduler in the standard IEEE 802.16e is illustrated in the following Figure 3:

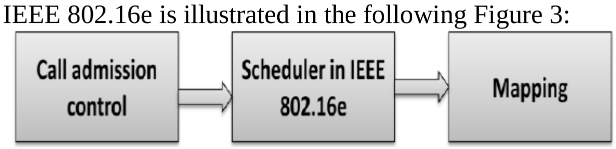

Fig 2: A simplified diagram of the scheduler

In CAC block any one of the bandwidth distributing mechanisms can be adopted between service classes and we assume that all connections accepted in the system are the result of applying this CAC strategy. In Scheduler block we choose the appropriate scheduler to schedule the packets for up-link/down-link. In mapping block the packets are directed towards the physical layer.

4. Results and Discussion

Below are the screen shots of our comparative study. We have done the comparison of the various protocols as described earlier. Below is the project model of our network.

Fig 3. Network Diagram of WiMax

Fig 3. denotes the network diagram of wimax which includes the comparative study of several scheduling schemes named MWRR, DWRR, PFS, MPQ and CAC. In the current scenario we worked with 35 nodes and 7 base stations.

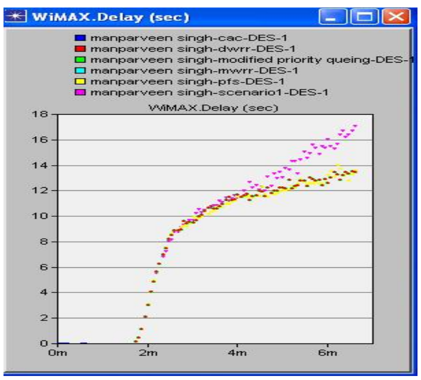

Fig 4. Delay

Fig 4 describes about the delay parameter of described protocols.

Fig 4 denotes the results of delay of various scheduling schemes with traffic imposed like voice and video. The above graph depicts that the MPQ and PFS are performing the best results in the comparison. Delay represents the lag time between the traffic received and traffic sent.

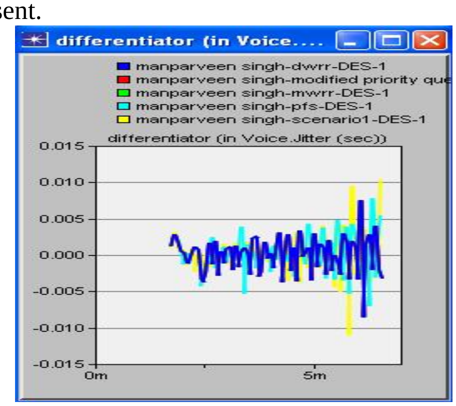

Fig 5 describes about the end to end delay parameter.

Fig 5 denotes the results of jitter of various scheduling schemes with traffic imposed like voice and video. The above graph depicts that the MPQ and PFS are performing the best results in the comparison.

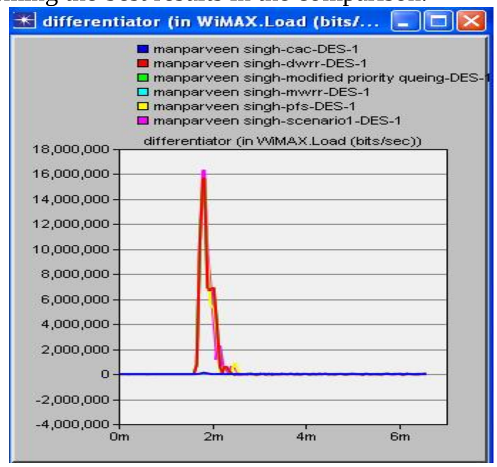

Fig 6. Describes out the load in the wimax network

Fig 46 denotes the results of load of various scheduling schemes with traffic imposed like voice and video. The above graph depicts that the MPQ and PFS are performing the best results in the comparison. Load defined above is stated in terms of packets per seconds.

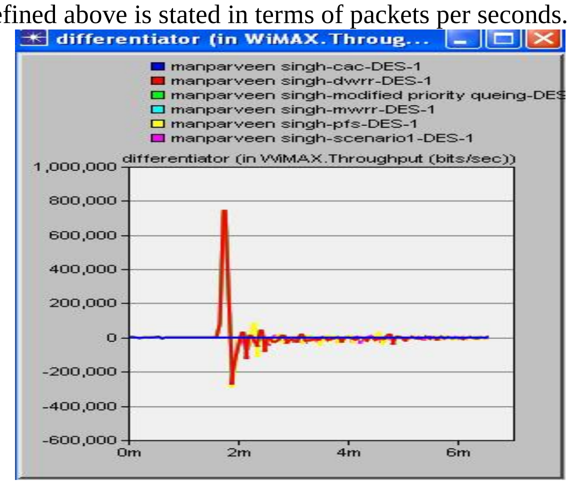

Fig 7. Throughput in the WiMAX network

Fig 7 denotes the throughput of various scheduling schemes. The above graph depicts that the DWRR and MPQ are performing the best results in the comparison. Throughput defined above is bits per seconds.

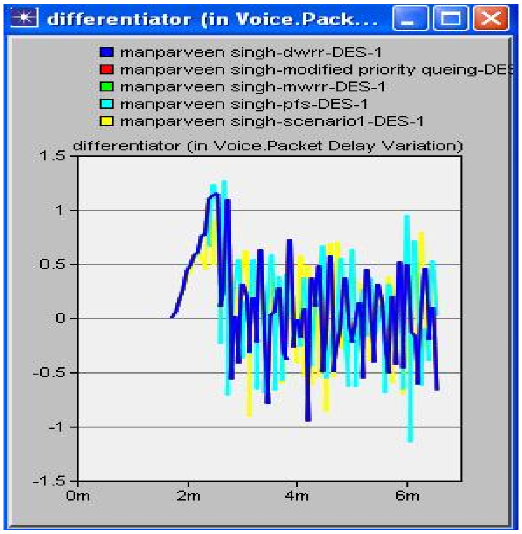

Fig 8. Packet Delay Variation

Fig 8 depicts about the packet delay variation in voice type of traffic. Packet delay variation in the PFS is less than that of other scheduling schemes in WiMAX.

5. Conclusion

In conclusion, the investigation of the behaviors of several wireless scheduling algorithms namely DWRR, PFS, MWRR, CAC and MPQ has shown the strengths of some of the scheduling algorithms that were under study. In this comparative study MPQ and PFS show the good results in all above traffic generated. Finally, it is clear that there is not a single scheduling scheme that provides superior performance with respect to all the QoS requirements and characteristics of the IEEE 802.16 MAC layer.

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