QoS Support for Multimedia in IEEE 802.16 Networks
A Survey of Scheduling Techniques
(Research Proposal)
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Introduction to IEEE 802.16 Networks
IEEE 802.16 Networks, promoted by the WiMAX (Worldwide Interoperability for Microwave Access) forum, are intended to be the leading wireless technology for broadband connection in wide area networks. Its light infrastructure requirements make it easy and cheaper to deploy whenever and wherever the need arises. [1] Also the wireless nature allows mobility to the users of WiMAX service. Mobility is one of the most important features impacting the evolution of communication. [2]

There are two types of WiMAX architectures; point-to-multipoint(PMP) and mesh. PMP consists of a base station (BS) which serves all the subscriber stations (SS) in its range. There is no communication between SSs. They all communicate through the BS. The BS is concerned with the setting up and management of the connections when an SS sends a request. The BS acts as a network gateway. In case there is communication between SSs as well, then it forms mesh architecture. The mesh architecture allows a connection over several hops and a tree network topology can be formed. The mesh and PMP are incompatible because PMP is only capable of single hop transmission. PMP has a lower signaling overhead than the mesh mode [1], [7]

For data transfer in WiMAX, downlink and uplink subframes are duplexed using either frequency-division duplex (FDD) or time-division duplex (TDD). [3] It should be noted that WiMAX is a connection oriented network.

QOS Support in IEEE 802.16 Networks
Providing quality of service (QoS) simultaneously to services with different requirements is a much more difficult task in wireless mediums as compared to wired networks because of its highly variable and unpredictable nature in terms of time-dependence as well as location dependence. To cope with such issues, QoS in wireless networks is handled at the medium access control (MAC) layer. [3]

An exciting feature of WiMAX is its support for QoS. It classifies all traffic according to four types:

- Unsolicited Grant Services (UGS): because of a constant bit rate requirement, this category needs constant bandwidth allocation.
- real-time Polling Services (rtPS): because of realtime variable bit rate requirements, these applications need minimum bandwidth granted and have to request transmission resources by polling. Contention and piggybacking are not allowed.
• non-real-time Polling Services (nrtPS): because of non real time flows, this category requires traffic polling. Bandwidth requests are allowed when minimum bandwidth requirements are needed, otherwise contention and piggybacking are used.
• Best Effort Services (BES): best effort flows can make bandwidth request only with contention and no minimum resources allocation is granted. [4]

Current Handling of the Problem
To design a good scheduling algorithm, the following issues must be catered to:
• Bandwidth utilization must be efficient. For example, resources shouldn’t be allocated to a bad link.
• The scheduler should be able to cater to different QoS requirements with a guarantee on the long term throughput for all connections.
• The scheduler should be fair in both the long run as well as the short run.
• The scheduler should have a low complexity so that the decision making is rapid.
• The system should be scalable. [5]

It is interesting to note that WiMAX standard does not specify the type of scheduling algorithm to be used and instead leaves it to the discretion of the vendor. Also the scheduling at the BS determines how much total bandwidth is to be allocated to each SS. It does not differentiate between the different traffics destined for the same SS. Thus the scheduling for these different traffics is done at the respective SS. [4]

Much research work has been done in this area which proposes complex schedulers in some cases a hierarchy of schedulers, such as Earliest Deadline First (EDF), Deficit Round Robin (DRR), Weighted Fair Queuing (WFQ), and Worst-case Weighted Fair Queuing (W2FQ) etc. In other cases simpler scheduling techniques used in wired networks are also proposed for WiMAX. [6]

My Area of Focus
For this project I intend to focus on scheduling techniques for QoS support in WiMAX at the BS. I intend to do a vast survey and critically review the existing scheduling techniques to compare their strengths and weaknesses. I will support my findings with simulations. In the process, I also hope to find any open issues and research challenges for future direction. Keeping in mind the current interest in multi hop networks, if I get time, I may extend my research to scheduling in multi hop WiMAX networks as well.

References