Admission Control and Packet Scheduling for IEEE 802.16 Standards

Samuel K. Falowo and Neco Ventura
Department of Electrical Engineering,
University of Cape Town, Private Bag, Rondebosch 7701, South Africa.
Tel: +27 78 057 7078, Fax: +27 21 6503465
email: sfalowo@crg.ee.uct.ac.za

Abstract - Admission control and packet scheduling mechanisms are used in service differentiation and QoS support. Implementation of these mechanisms in IEEE 802.16 is vendor specific. This paper states the problems and proposes solutions for admission control and packet scheduling in IEEE 802.16 networks. The proposed algorithms will enhance bandwidth utilization and guarantee QoS for different types of service. We consider bandwidth polling overhead incurred by services being requested and fairness in resource allocation.

Index Terms—QoS, Admission Control, Scheduling

I. INTRODUCTION

The IEEE 802.16 Standard for WiMax [1] defines an architecture with a base station (BS) and a number of subscriber stations (SSs). Point-to-multipoint (PMP) and Mesh modes are defined in the standard. PMP mode is considered in this paper. MAC scheduling services and their associated QoS parameters are also defined in the standard. The scheduling services are Unsolicited Grant Service (UGS), real time Polling Service (rtPS), non-real time Polling Service (nrtPS), Best Effort (BE) service and the extended real time Poling Service (ertPS) added in 2005 [2]. One or more of the following QoS parameters namely maximum sustained traffic rate (MSTR), minimum reserved traffic rate (MRTR), maximum latency, tolerated jitter, traffic priority and request / tranmission policy are associated with the scheduling services named above. There is need to integrate admission control and packet scheduling mechanisms in other to meet the QoS requirements of these services. Currently this is not defined in the standard but instead is left to the vendors. This paper states the problems and proposes solutions for admission control and packet scheduling in IEEE 802.16 networks.

The rest of the paper is organized as follows: section II gives the literature review, section III describes the proposed algorithms. Conclusions are given in section IV.

II. LITERATURE REVIEW

Some works have been done on packet scheduling for the IEEE 802.16 standard. Spyros et al [3] propose a scheduler called Frame Registry Tree (FRT) to classify the uplink and downlink transmissions in a convenient manner by reducing the BS offline computation time. The scheduler achieves throughput for higher priority flows, but lower priority flows are lead to starvation. Thus the algorithm has a problem of unfairness to some service flows. In [4], the work is extended and a Coloured- FRT Scheduler (C-FRTS) is proposed to protect lower priority flows. However, the scheduler is complex. These works stated above only consider packet scheduling. To improve the QoS provided to different service types, there is need to integrate admission control and packet scheduling. Ganz et al [5] in their work propose a scheduling mechanism that uses hierarchical structure for bandwidth allocation and admission control mechanism based on mrtr. The mechanism provides bandwidth utilization to some service types while it is unfair to others. Chen et al [6] propose admission control and packet scheduling. The admission control is based on mrtr. A connection is accepted if there is available bandwidth to sustain its MRTR. A two-layer scheduling mechanism is also proposed to solve the unfairness issue. However, it results to a complex scheduler. Ch-Hong et al [7] propose a Connection Admission Control (CAC) and packet scheduling mechanism using token bucket. Each connection is controlled by token rate and a bucket size. The scheme delivers higher throughput when compared with hierarchical structure mechanism. However, it needs an estimation model, in which the performance depends on the accuracy of the model. Sarat et al [8] considers admission control based on the available bandwidth and deadline constraint of the connections. While the method ensures no packet misses its deadline, it results in low utilization of resources and the algorithm complexity is high. In [9] the authors propose a CAC algorithm that accepts connections based on MRTR, unsolicited grant interval and unsolicited polling interval. The scheduler uses three priority queues and dual leaky bucket method. The mechanism guarantees maximum latency, however, computation overhead is incurred in the base station.

III. ADMISSION CONTROL AND PACKET SCHEDULING

A. *Identified problems*

From our literature review, three problems are identified: unfairness in allocation of resources among different service flows; scheduling algorithms are based on hierarchical structure which results in computation complexity; and some of the admission control mechanisms proposed for IEEE 802.16 standard are based on MRTR without considering the polling overhead incurred by the type of service being solicited.

B. *Proposed solutions*

As shown in fig. 1, a connection must be established with the BS before a transmission can take place in the uplink direction. The admission controller determines whether to accept or reject the connection request. The scheduler schedules which of the newly admitted connections and the active connections will transmit in the next uplink sub-frame and the information is mapped to the subscriber stations (SSs). To provide the QoS required, there is need to consider the overhead incurred by the type of service being solicited (for example, the polling grant required by the rtPS to make bandwidth request). With respect to this, the proposed admission controller is going to consider the bandwidth required to sustain the MRTR and the overhead incurred by the type of service being solicited. The Scheduler will be designed to meet latency bounds of rtPS by scheduling data before its deadline. The fairness issue will also be addressed. Analytical methods and network simulations will be used for performance analysis. The performance of the algorithm will be evaluated using the following metrics: blocking probability, delay, packet loss and throughput. We shall compare our work with the existing works in literature.

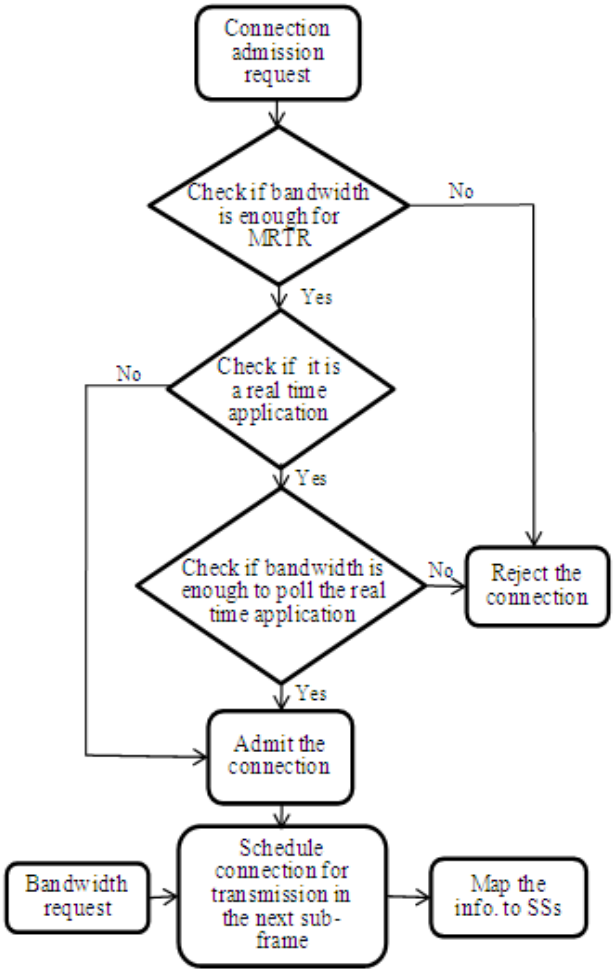

Fig 1. A flow chart showing Admission Control and Uplink Scheduling at Base Station (BS).

IV. CONCLUTION

To support the QoS requirement in the IEEE 802.16 standard, we have proposed admission control and packet scheduling mechanisms that consider the MRTR and the polling overhead incurred by the type of service being solicited, with fairness among different service flows. The performance of the proposed algorithms will be evaluated and the results will be compared to existing mechanisms. In our future work we shall simulate the algorithms and produce results.

V. REFERENCES

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Samuel K. Falowo received his undergraduate degree in 2008 from the Federal University of Technology, Akure, Nigeria and is presently studying towards his Masters degree in Electrical Engineering Department at the University of Cape Town. He is working with focus on Admission Control and Packet Scheduling for IEEE 802.16 Standards.