Chapter 11

Mobile WiMAX Bandwidth Reservation Thresholds: A Heuristic Approach

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ABSTRACT

This paper addresses the issue of wireless bandwidth partitioning of a Mobile WiMAX cell. The authors consider a Complete Partitioning strategy, where the wireless bandwidth capacity of a cell is divided into trunks. Each partition is strictly reserved to a particular type of connection. Four IEEE 802.16e 2005 service classes are distinguished: UGS, rtPS, nrtPS, and ErtPS. The authors consider mobility and differentiate new call request from handoffs. In addition, the authors take into consideration the Adaptive Modulation and Coding (AMC) scheme, through the partition of the cell into different areas associated to a particular modulation and coding scheme. The purpose of the paper is to determine, using an analytical model and a heuristic approach, the nearly optimal sizes of the partition sizes dedicated to each type of connection, which is characterized by its service class, type of request and modulation, and coding scheme.

INTRODUCTION

This work focuses on IEEE 802.16e-2005 WiMAX network with Wireless MAN OFDMA physical layer. This technology, also referred as a mobile WiMAX, aims to offer a quadruple-play service to multiple mobile subscribers (MSS), which can have access anytime and anywhere to various application types, like file downloading, video streaming, emails and VoIP with and without silence suppression. In order to guarantee the quality of service required by these applications, the standard defines five service classes. Namely: UGS for VoIP without silence suppression, rtPS for video streaming, nrtPS for file downloading, ErtPS for voice with silence suppression and
finally BE for web and mailing applications. For notation simplicity, we will refer to UGS, rtPS, nrtPS, ErTPS and BE as a class 1, 2, 3, 4 and 5 respectively. Let C={1,2,3,4,5}. In our work we will only study class 1,2,3 and 4 as BE service does not requires any QoS guarantees.

WiMAX network is like a cellular network, as we see in Figure 1 there is a base station (BS) that communicates with many subscribers station (SS) in down-link (from the base station) and up-link (to the base station).

IEEE 802.16 supports very high bit rates in both up-link and down-link in a large coverage.

This is why this technology is suitable for stringent QoS requirements of multimedia applications and it can handle such services as VoIP, VoD, or IP connectivity.

In order to guarantee these QoS constraints, the WiMAX provider must use an efficient call admission control (CAC) mechanism and bandwidth allocation. This work is interested on dimensioning a WiMAX network by giving a method of how to configure parameter settings of such CAC for an optimal operating system which satisfies QoS constraints.

In this paper, we focus on Complete Partitioning as a wireless bandwidth allocation strategy for a mobile WiMAX network. The purpose of the paper is to determine, using an analytical model and a heuristic approach, the nearly-optimal sizes of the partition sizes which are dedicated to each type of connection in a aim to fulfill two objectives: (1) statistically guarantee that the connection blocking probabilities remains under a given threshold, and (2) maximize the average gain of the wireless link. As BE service does not requires any QoS guarantees, we distinguish in our model four IEEE 802.16e 2005 service classes: UGS, rtPS, nrtPS and ErTPS. We also differentiate new call request from hand off ones and we integrate in the system model the Adaptive Modulation and Coding (AMC) scheme.

The rest of this paper is organized as follows: the state of the art is presented in the next section. We then describe the most important concepts defined by IEEE 802.16e-2005 standard in physical and MAC layer that we used in our proposal. The system modeling and the problem formalization is also detailed. Our incremental Partition size algorithm is then presented. Finally, the evaluation of this proposal is discussed. Finally, the last section summarizes the paper.

STATE OF THE ART

In order to understand the allocation bandwidth strategy that we used for each service class in our proposal, this section gives an overview of the mostly used policies that a provider uses to allocate bandwidth between service classes.

Figure 1. Mobile WiMAX architecture