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ABSTRACT

The maturing of fixed Worldwide Interoperability for Microwave Access, WiMAX technology is making possible a number of exciting new applications that previously were limited by cost, distance and throughput requirements. With the latest wireless innovations, fixed wireless applications can now go beyond mere short-range data communications, and could be possibly implemented in a secure manner. Superior outdoor performance, proven Quality of Service, QoS and solid security enable WiMAX to support valuable multimedia applications, such as network video for surveillance. The IEEE 802.16 WirelessMAN standard which has emerged as Broadband Wireless Access, BWA solution, is promising to meet all such requirements and becoming the most popular way for wireless communication. The IEEE 802.16 advantages includes variable and high data rate, last mile wireless access, point to multipoint communication, large frequency range and QoS for various types of applications.

This thesis presents a performance analysis of Medium Access Control, MAC layer of IEEE802.16 using OPNET DOCSIS Module. IEEE 802.16 was largely based on Data Over Cable Service Interface Specification 1.1, DOCSIS 1.1, hence the basic protocol operation and QoS features of both protocols are the same. The impacts of the different WiMAX scheduling features on the different traffic classes are thoroughly investigated and analyzed.

IEEE802.16 MAC protocol includes QoS guarantees, but it does not provide a complete solution and does not describe how to schedule traffic to fulfill the QoS requirements specifically. Therefore, scheduling policies at the Subscriber Station, SS and the Base Station, BS are proposed in this project. Detailed analysis of the network performance is provided through extensive simulations.

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CHAPTER 1
INTRODUCTION

1.1 Broadband Wireless Access, BWA and IEEE802.16 MAC Protocol

IEEE 802.16 architecture consists of two kinds of stations: Subscriber Stations, SS and a Base Station, BS[6]. The BS regulates all the communication in the network, i.e. there is no peer-to-peer communication directly between the SSs. Each SS can deliver voice and data using common interfaces, such as plain and telephony service, Ethernet, ATM, video, VOD and other services with different QoS requirements. The communication path between SS and BS has two directions: uplink channel (from SS to BS) and downlink channel (from BS to SS). The downlink channel, defined as a direction of data flow from the BS to the SSs, is a broadcast channel, while the uplink channel is a shared by SSs. Time in the uplink channel is usually slotted (mini-slots) called by Time Division Multiple Access, TDMA, whereas on the downlink channel BS uses a continuous Time Division Multiplexing, TDM scheme[7]. Physical layer was defined for a wide range of frequency from 2 up to 66 GHz. In sub-range 10-66 GHz the system is an assumption of Line-Of-Sight, LOS propagation. In this scheme single carrier modulation was chosen, because of low complexity of system. Downlink channel is shared among users with TDM signals. Access in uplink is being realized with TDMA. Channel bandwidths are 20 or 25 MHz in USA and 28MHz (Europe). Duplex can be realized with either Time Division Duplex, TDD or Frequency Division Duplex, FDD scheme. In the 2-11 GHz bands communication can be achieved for licensed and non-licensed bands. The communication is also available in Non-Line-Of-Sight, NLOS conditions.

The 802.16 MAC layer is designed to support a point-to-multipoint architecture with a central BS handling multiple independent sectors simultaneously. On the downlink, data to SSs are multiplexed in TDM fashion. The uplink is shared between SSs in TDMA fashion. The 802.16 MAC is connection-oriented. All services, including inherently connectionless services, are mapped to a connection. This provides a mechanism for requesting bandwidth, associating QoS and traffic parameters, transporting and routing data to the appropriate convergence sub layer, and all other actions associated with the contractual terms of the service. Connections are referenced with 16-bit Connection Identifiers, CIDs and may require continuously granted bandwidth or bandwidth on demand. Upon entering the network, three management connections are established, in both directions.

1.2 Standardization in the BWA Industry

The design of early BWA systems, especially Local Multipoint Distribution Service, LMDS networks, was driven by the guidelines set for digital TV broadcasting and video-on-demand. These services required limited interactivity. Standardization for such systems was first initiated by the Digital Video Broadcasting, DVB project conducted by the European Broadcasting Union. The DVB specifications were originally meant for satellite and cable networks. In a separate effort, the Digital Audio Visual Council, DAVIC was formed to standardize LMDS and Microwave Multipoint Distribution System, MMDS in addition to satellite and cable networks. Although DVB and DAVIC started out as two separate standards, the European Telecommunications Standards Institute, ETSI brought them together as DVB/DAVIC [8].