Chapter 13
Analysis of VoIP Traffic over the IEEE 802.16 Protocol

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ABSTRACT

Voice over Internet Protocol (VoIP) is one of the fastest growing applications for the Internet today and is a very important service because mobile users can utilize voice services more cheaply compared with most mobile systems. A crucial application over these networks is VoIP over the Worldwide Interoperability for Microwave Access (WiMAX), which is one of the technologies in Broadband Access Networks based on IEEE 802.16 standards. It provides high throughput broadband connections over long distances, which supports Point to Multi-Point (PMP) wireless access. A hurdle, however, is the number of voice connections that can be supported. Since VoIP requires short end-to-end delays, supporting as many VoIP users as possible in a mobile broadband wireless access network, considering limited radio resources, becomes a very important issue. In this chapter, the authors use a theoretical model and an algorithm to evaluate the performance of some of the most important VoIP codecs.

INTRODUCTION

Broadband Wireless Access (BWA) networks will revolutionize the way wireless communication is used today for the transmission of mobile, nomadic and fixed digital applications and services for the next generation of cellular systems. Global trends indicate that Long Term Evolution (LTE) release 8 (LTE Standard, 2009), LTE-Advanced (LTE release 10, 2011) and IEEE 802.16m-2011 (IEEE 802.16m, 2011) will emerge as new technologies to provide data rates above 300 Mbps, or even higher than 1 Gbps with advanced PHY (physical) layer characteristics. These new systems are...
the best BWA technologies that will support the increased demand of fourth generation (4G) traffic, which will include a larger number of subscribers and active simultaneous requested services per a mobile user such as video conferencing and video streaming applications using a very large radio bandwidth.

BWA has become the best option to meet residential and small business demand for high speed Internet access and multimedia services. However, the wide-scale adoption of BWA systems will be determined by its ability to overcome cost and performance barriers. If BWA can meet these challenges, it could easily be the next revolution in wireless systems after WLAN.

The great demand for high speed Internet access, voice and video applications, combined with the global tendency to use wireless devices, have given sprouting for BWA networks. A solution for BWA networks are the IEEE 802.16m-2011 and the IEEE 802.16e-2005 (IEEE 802.16e, 2005) standards which supports mobility speeds up to 120 km/h with an asymmetrical link structure and allows Subscriber Stations (SSs) to have a handheld form factor, well suited for mobile devices, like PDAs (Personal Digital Assistants), cell phones, laptops, tablets, among others.

The diverse options offered by the BWA standards have increased the interest of the research community, manufactures, and operators about what type of performance can be expected from IEEE 802.16-2004 (IEEE 802.16, 2004), IEEE 802.16e-2005 and recently IEEE 802.16m-2011 protocols in the near future. In the rest of this chapter we refer to these three versions of the standard only as IEEE 802.16.

As the BWA has had one of the most notable growing up in recent years on the telecommunications industry’s history, the growing up has driven the demand of high speed Internet data services. Broadband users around the world hope these services can support speed web browsing, high data rates on file downloads, interactive games and real time multimedia applications such as conferences and VoIP (Voice over IP) services.

With the constant development of mobile devices a great deal of attention has been attracted by VoIP services, because it is expected to be widely supported by mobile wireless networks, such as the IEEE 802.16 protocol. These multimedia applications are very important because mobile users can utilize VoIP services cheaper than mostly actual mobile systems. Therefore, supporting as many VoIP users as possible in a mobile wireless network using limited radio resources is a very important issue.

However, performance of VoIP services is affected by several issues defined in the IEEE 802.16 standard, as such as signaling overhead of MAP messages, ranging regions and wasted symbols due to “rectangulation and quantization”, among others.

Here we defined “rectangulation” as the process of allocating bandwidth resources in the downlink (DL) channel on a square or rectangle region of the frame structure. Also we defined “quantization” as the process of allocating these resources using the minimum allocation unit, denominated “quantum map”. Considering Partial Usage of Sub-Channels (PUSC), a quantum map or a slot in the DL channel is one subchannel per two OFDMA (Orthogonal Frequency Division Multiple Access) symbols. A quantum map in the uplink (UL) channel is one subchannel per three OFDMA symbols, as we depicted in Figure 1.

These settings seriously affect VoIP service performance because a VoIP packet allocation generally does not fit well in the DL and UL reservation space and usually multiple quantum maps are required. Signaling overhead of MAP messages also affects VoIP services, because such overhead increases when the Base Station (BS) schedules small-sized VoIP packets.

Some studies have evaluated VoIP performance taking into consideration mapping overhead (So, 2007) and (So 2009). However, in these studies neither wasted resources in the DL channel due to
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