Chapter 12
System Design Perspective: WiMAX Standards and IEEE 802.16j Based Multihop WiMAX

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ABSTRACT
The next generation of cellular networks has evolved from voice-based to data-centric communication. The recent focus has been mainly on high data-rate services like mobile gaming, high quality music, Internet browsing, video streaming, etcetera, which consumes lots of bandwidth. This puts a severe constraint on the available radio resource. In this chapter, the IEEE 802.16 based multihop WiMAX networks (802.16j) is introduced, and the system design is explained in detail. The chapter outlines the background and the importance of multihop wireless networks, especially in the cellular domain. Different types of multihop design for WiMAX are explained, along with a detailed analysis of the effect of the number of hops in the WiMAX networks. Further, in order to support next generation rich media services, the system design requirements, and challenges for real-time video transmission are explained.

INTRODUCTION TO WiMAX
The Worldwide Interoperability for Microwave Access, abbreviated commonly as WiMAX is a wireless technology aimed to provide a standard based solution for broadband data access to fixed, portable and mobile devices. WiMAX has gained significant prominence from 2005, since the origin of WiMAX certified products. The mobile WiMAX air interface is designed based on orthogonal frequency division multiplexing (OFDM) technique. Importantly, it relies on the IP network architecture and is mainly developed to realize the convergence of fixed and mobile
broadband in the wireless cellular network. The WiMAX air interface is developed by the IEEE 802.16 working group established by the IEEE Standards Board in 1999. The IEEE 802.16 standards define the structure of the PHY layer (layer 1) and MAC layer (layer 2) operations that occur between the mobile subscriber stations and BSs over the air while the upper layer signaling over the air is considered to be out of scope of the IEEE 802.16 definition.

Sub-Groups in WiMAX

The initial versions of the standard focus 802.16/a/d focused on the fixed access and the later versions include many new features and functionalities needed to support enhanced QoS, increased coverage, better mobility and high security (Etemad, 2002). The work group organization of IEEE 802.16 and the different sub groups are shown in Figure 1. The 802.16 working group has different sub-groups, the 802.16g, 802.16h, 80.216m, etc. each designed for different purpose that includes advanced air interface, co-existence, etc. Given the importance of high rate communications in the next generation wireless network, the “relay group” proposed the IEEE 802.16j mobile multihop sub-division, as a method to integrate multihop ad hoc networking into cellular networks.

Why Multihop WiMAX?

The network operators and the service providers constantly look for higher system capacity and network coverage, while at the same time aim to reduce the cost of cell-site developments and maintenance. Due to the varying topography and constant irregularities in the coverage area, novel mechanisms have to be proposed in order to increase the system capacity. In this context, a relay based cellular network is a key architectural advancement towards the next generation wireless networks. The next generation broadband wireless network would comprise of both multihop
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