Chapter 11
Recent Advances and Challenges in Wireless QoE-Aware Multimedia Streaming Systems

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ABSTRACT

It is expected that multimedia applications will be the most abundant application in the Internet and thousands of new wireless and mobile users will produce and share multimedia streaming content ubiquitously. In this multimedia-aware system, it is important to assure the end-to-end quality level support for video and voice applications in wireless systems. Traditional Quality of Service techniques assure the delivery of those services with packet differentiation assurance and indicate the impact of multimedia traffic only on the network performance; however, they do not reflect the user's perception. Recent advances in multimedia are exploring new Quality of Experience approaches and including metrics and control schemes in wireless networking systems in order to increase the user´s satisfaction and optimize network resources. Operations based on Quality of Experience can be used as an indicator of how a networking environment meets the end-user's needs and new assessment and packet control approaches are still important challenges. This chapter presents an overview of the most recent advances and challenges in assessment and traffic conditioner procedures for wireless multimedia streaming systems.

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In addition, an intelligent packet dropper mechanism for IEEE 802.11e systems is proposed and evaluated by using the Network Simulator 2, real video sequences and Evalvid tool. The benefit and the impact of the proposed solution is evaluated by using well-know objective and subjective Quality of Experience metrics, namely, Peak Signal-to-Noise Ratio, Video Quality Metric, Structural Similarity Index and Mean Option Score.

INTRODUCTION

Recently, advances in multimedia and mobile communications have emerged to offer a novel and comfortable living style for users. In this context, the delivery of multimedia content, such as video streaming, anytime, anywhere and with an end-to-end quality level support is a key requirement. This fact explains the increase of wireless networking standards, such as the *Institute of Electrical and Electronics Engineers* (*IEEE*) 802.11 (Lidinsky, Chambers & Jeffree, 2001) and IEEE *8*02.16 (Marks, Stanwood, Eklund & Chang, 2004) as well as the emerging new multimedia streaming applications.

With respect wireless systems, the IEEE 802.11 standard provides communication coverage limited to an area of 100m and can also operate in mesh mode, IEEE*8*02.11s (Akyildiz & Wang, 2005), to increase the coverage area. The IEEE 802.16 was designed to work in outdoor scenarios, with a range of up to 50km and rates of up to 75 Mbps for architectures fixed (IEEE 802.16d), and coverage of up to 4km and bandwidth up to 15 Mbps for mobile devices (IEEE 802.16e). The wireless facility can allow the ubiquitous access of multimedia content with low operational cost. It is expected that video-based services will account for 50 percent of all consumer network traffic in 2012 and 80 percent in 2020.

In order to keep and attract customers, wireless operators must also provide quality level assurance for multimedia applications in order to maximize the user's satisfaction and the usage of network resources, while increasing the profits of network providers. However, wireless and multimedia-aware *Quality of Service* (*QoS*) assessment and management schemes must be implemented to fulfill such important requirement.

To cope with QoS issues in *Wireless Local Area Network* (*WLAN*), the IEEE802.11e working group was created, where the draft version brought new *Media Access Control* (*MAC*) improvements incorporated in the IEEE 802.11 standard (IEEE 802.11e, 2010). To provide QoS assurance, eight *User Priorities* (*UP*s) were defined. Each packet is assigned to an UP and mapped to an *Access Category* (*AC*). Each AC is directly mapped to a queue, where several queues have different priorities, and applications are assigned to them according to requirements, policies, content, among other parameters.

In the case of broadband access in *Wireless Metropolitan Area Network* (*WMAN*), the *Worldwide Interoperability for Microwave Access* (*WiMAX*) system (IEEE *8*02.16 standardized the architecture for all-*Internet Protocol* (*IP*) networks) is the most attractive solution to last mile connectivity to Internet with quality level assurance. The WiMAX system provides differentiated levels of QoS for multimedia applications, based on the combination of a set of communication service classes, supported in both wired IP-based and wireless IEEE 802.16-based links. In the former, network elements with standard IP QoS models, such as *Differentiated Services* (*DiffServ*), can be configured to guarantee QoS support for sessions crossing wired links. In the latter, several IEEE 802.16 QoS services are defined to provide packet differentiation in the wireless interface (Andrews, Ghosh & Muhamed, 2007).

As presented above, the current wired and wireless techniques that aim to maximize the quality level of multimedia services in a networking