Chapter 22
Video Streaming Based Services over 4G Networks: Challenges and Solutions

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ABSTRACT

4G networks must not only show high bandwidth but also provide an excellent user experience, especially for video streaming, which is a key technique for multimedia services on 4G networks like Voice over Internet Protocol (VoIP), Television over IP (TvIP), broadcatching, interactive digital television, and Video on Demand (VoD). These services are challenging because of the well-known problems of the radio channel. Efficient solutions are designed by considering cross layer techniques. In this chapter the authors firstly review a number of video streaming based services, and then they present the basic operation of the video streaming and its problems in 4G networks, emphasizing Wireless Fidelity (WiFi) technology. In order to solve these problems they propose two cross layer strategies (one for access networks and another for ad hoc networks) and integrate the first one into two application level solutions. The authors test the user experience that accesses a Web portal including a VoD with a mobile telephone equipped with WiFi and High Speed Downlink Packet Access (HSDPA) Wireless Network Card Interfaces (WNIC). Results invite them to be optimistic.

1 INTRODUCTION

A real time multimedia system manages synchronized information with different semantic interpretations (usually video, audio and text). The processing and communication of this information can be naturally split in different units (images, a portion of audio between two silences, etc.). The processing results not only must be correct, but they also must be produced before a temporal deadline well established for each unit. Eventually the managed information must be communicated using any kind of network (internal to a machine or using the wide Internet). Working with multimedia communication deadlines is a very complex task.

DOI: 10.4018/978-1-61520-674-2.ch023

The convergence between telecommunication and computer communication has led to new set of multimedia services like videoconferencing, VoIP, instant messaging, and gaming. The massive use of these services speaks about their importance in the area of Communication and Information Technology and their impact on Information Society.

The communication of multimedia services results tends to be delay sensitive, bandwidth intense and loss tolerant. For this reason, it is very important to deliver the units of multimedia information such that the end user has a good experience. Whenever a real time communication or computation task(or a combination of both) can be split into others of less complexity, it will be possible to use the streaming technique to deliver (process) the units of information efficiently by overlapping communication and processing actions. Several examples are: Efficient Instruction Stream hiding memory latency compared with processor speed rate (Rodriguez & Campelo, 2003), Lot Streaming Technique for the Job-Shop Scheduling problem (Chan & Wong, 2005), and Media Streaming or Video Streaming techniques for multimedia information delivering in a traditional multimedia e-learning system (Ming, 2000). Media Streaming is used to reduce the delay requirements of multimedia services using efficiently the network bandwidth. Sometimes, this technique, when used for delivering multimedia information stored in a server is simply named streaming. This term is not used in cases where the server delivers real time video.

In the last ten years digital wireless networks have experienced a great evolution and social implantation (Pagani, 2005). Their evolution continues constantly due to operators and vendors that want to stay competitive, offer better provisioning, and provide more cost-efficient provisioning of old services as well as new services (Dahlman & Parkval, 2007). This means seeking a more efficient system for adapting and reconfiguring the wireless channel (while taking into account the number of active users), adapting the Medium Access Control (MAC), and considering the upper layers seeking a good routing algorithm, transport protocol, security procedures, mobility management, etc. (Savo, 2006). Moreover, they must satisfy the user's requirements presented in (Pagani & Schipani, 2005) specifically for multimedia services.

In the wireless network marketplace there is a true jungle of technologies: Zigbee (for multimedia wireless sensor networks), Bluetooth and WiFi (reviewed in (Ganz & Ganz, 2004)) Mobile Worldwide Interoperability for Microwave Access (WiMAX) (Cheng & Marca, 2008), wireless mesh networks (Aggelou, 2009), Radio Frequency Identification (RFID) (Ahson & Ilyas, 2008), and Satellite or similar (Zavala & Ruíz, 2008), among others. Evolution of other technologies like Long Term Evolution (LTE) (Holma & Toskala, 2007) is thought to be the core of the 4G cellular telephony network. In terms of transmission speed the objective of 4G wireless networks is to achieve 1 Gbps for Wireless Local Area Networks (WLAN) and 100 Mbps for mobile telephone networks.

The tremendous evolution of wireless networks has met the powerful hardware and software architecture of new mobile telephones. This architecture usually includes several on-chip WNIC like Bluetooth, WiFi, Global Positioning System (GPS), WiMAX, etc. Their computing powers allow them to receive multimedia streaming information at very low cost from a VoD server. This makes the efficient implementation of streaming techniques over wireless network a very important challenge. It is also an interesting challenge to achieve because there are a large number of mobile devices on the market.

The design of solutions to the challenge of streaming over 4G networks requires good knowledge about their characteristics, because it is well known that wireless channels present a set of problems: frequently packets are delayed, lost or even discarded. These problems lead to an unsatisfactory user experience. Moreover, all 4G wireless technologies will present this set of prob-