Chapter XX
Streaming Multimedia via Peer-to-Peer Systems

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ABSTRACT

The concept of multimedia streaming gives the end-users the ability to playback various multimedia contents while they are still being downloaded from the provider. This provides a major advantage in which users do not need to wait for the whole media clips to be downloaded; it also reduces the time of delivery and allows their bandwidth to be efficiently used for other purposes. In this chapter, we review the advantages, limitations and challenges faced by current peer-to-peer approaches in multimedia streaming, taking a close look at the architectures, protocols, service quality, and case studies. Our analysis reveals that, when placed in the context of mobile systems, peer-to-peer streaming is still at its infancy. We illustrate shortcomings and provide an outlook for mobile peer-to-peer streaming, highlighting the most pressing research issues. The reader will appreciate the current state-of-the-art of this remarkable technology and ways in which it may become a reality.

INTRODUCTION

Multimedia streaming allows for media clips to be distributed by content providers to the end users, allowing them to effectively manage bandwidth and reduce the waiting time for download. This approach has been used to deliver various multimedia content such as audio, video and games. The main motivation behind multimedia streaming is that the end users only use a fraction of their bandwidth by receiving smaller chunks of the media clips which are first stored in a playout buffer. The multimedia content is then played out from the buffer as a continuous stream.

This approach of multimedia streaming has been deployed in both fixed and mobile networks using client-server architectures. In a client-server architecture, a client hosts requests and

receives media clips from an always-on server. The centralized platform of client-server architectures acts as a single point of failure because if the server goes down, the clients experience a total denial of service. In order to support multimedia streaming, content providers use various underlying network technologies but the most common are IP multicasting which uses special multicast routers to sends packets to the whole system, thus flooding the network with many packets. The other alternative is to use content distribution networks (CDNs), in which servers are replicated and placed in close proximity to users. This architecture improves the quality of streaming because the contents are easily located. However, the overhead cost of maintaining this architecture is very expensive especially taking into consideration the costs of bandwidth and resources.

Due to the limitations in the existing technologies, there have been recent deployments of decentralised approaches to streaming using the advantages of peer-to-peer (P2P) approaches as found in file-sharing applications. These P2P streaming architectures allow multimedia streaming to be achieved with minimal centralization or in some cases, in serverless environments. P2P streaming architectures employ the use of P2P properties and advantages such as resource look up, scalability and redundancy to achieve the centralized server roles in conventional P2P streaming, thereby achieving streaming without the use of any servers. This method has the major advantage of reducing maintenance costs while providing a more scalable and redundant platform, which allows end nodes to grow into millions of users (Wen, Longshie & Oiang, 2006).

One of the major drawbacks of this approach is the intensive use of resources and the large amount of signalling that is required in maintaining the overlay network. Other challenges such as security, interoperability and digital rights managements are also factors that affect the performance of this architecture. Notwithstanding, there have been various deployments of such P2P streaming over the Internet with acceptable performance but little is known about such deployments in mobile environments.

In this chapter we start off by discussing the issues facing multimedia streaming over P2P systems in converged networks, giving a brief description of some of these P2P streaming technologies. We then illustrate how they are mapped over fixed and mobile network architectures. Secondly, we specifically look at these P2P streaming technologies in a mobile environment where new challenges such as mobility, security, processing power and battery power are introduced into the system. A survey of current commercial, research work and state-of-art mobile P2P streaming are also presented. Finally, we look at open issues and challenges of implementing mobile P2P streaming and then make recommendations for future work and research in the area of mobile P2P streaming.

BACKGROUND TECHNOLOGIES

The concept of P2P technologies were first applied to file-sharing application in which equal peers form an overlay network to allow them to share and locate files within the overlay network. The overlay network is usually formed with little regard with the underlying network but newer P2P applications now put the network topology into consideration. P2P technologies are no longer limited to file sharing but are now being extended to other applications such as Voice over IP and multimedia conferencing as in Skype (Hoßfeld & Binzenhöfer, 2007), collaborative environments (Leuf, 2002) and multimedia streaming (Wen, 2006). In this section we discuss three broad approaches to multimedia streaming, looking at their advantages and limitations, how these approaches are mapped to the underling networks in both fixed and mobile networks and properties that are needed in a mobile P2P streaming application.