Chapter XXVIII
Novel Results on MBMS Service Provisioning in UMTS/WLAN Heterogeneous Architectures

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ABSTRACT

The support of broadcasting and multicasting as an efficient L3-based service poses rigorous requirements to the next generation mobile communication architectures. When IP multicasting has been seriously considered in mobile systems, soon has emerged the proposal of Multimedia Broadcast Multicast Service (MBMS) for 3G networks and beyond. However, with the spreading of versatile heterogeneous wireless systems, like the cooperation of European 3G (UMTS) and Wireless Local Area Network (WLAN), the problem of wireless IP datacasting arises in more complicated ways. In order to extend MBMS for UMTS/WLAN heterogeneous architectures we approach a novel framework along with a suitable and efficient WLAN MAC (Media Access Control) extension. In this work we also evaluate the performance of our proposal using a discrete event simulation environment called OMNeT++.

INTRODUCTION

As a result of recent years' rapid development in both wired (xDSL, DOCSIS) and wireless (UMTS—Universal Mobile Telecommunications System, WiMAX, WLAN—Wireless Local Area Network) access networks, heterogeneous network architecture has been created. However, the heterogeneous nature of networks offers a wide range of possible applications. It is important to note that various available access networks enable the users to connect always to that access network which they prefer the most, according to the Always Best Connected (ABC) concept (Gustafsson & Jonsson, 2003) The access technology selection criteria can be determined by either the terminal (available bandwidth or application requirements) or the end-users' preferences (cost) or even by the network (network management issues). Based on the constructed criteria functions an efficient vertical handover solution should be implemented to achieve the best performance possible. In order to comply with the vertical handover requirements the criteria function for the ABC concept needs to be robust to avoid ping-pong sequences between different access technologies and to be seamless. However, not only appropriate vertical handover method is needed to achieve optimal performance, but the applications should also be adapted to the wireless environment. It is getting more important to provide efficient usage of resources for the emerging multimedia applications over heterogeneous networks. Multimedia applications have different needs as other data applications since constant bandwidth and low jitter can be crucial. Thus point-to-multipoint applications—such as mobile TV broadcasting—that put serious demands on the scarce radio resources might be modified. Two different point-to-multipoint schemes are distinguished according to the grouping concept of the destination nodes. On one hand in case of broadcasting all the simultaneously connected nodes will receive the packets. On the other hand in case of multicasting certain user groups can be addressed as destination by means of complex registration processes performed by the end-users.

As a part of the 3GPP task force activity the Multimedia Broadcast Multicast Service (MBMS) concept was created to establish a work frame for the point-to-multipoint downlink bearer service for IP data in UMTS environment (3GPP, 2007, June 19th; 3GPP, 2007, July 25th; 3GPP, 2007, July 31st). However, currently there is no standard that could serve as an MBMS extension to other access networks (e.g., WLAN or WiMAX). The UMTS offers widespread coverage area and high accessibility and mobility with low delay, but bandwidth remained still fairly low. As a result of low bandwidth the number or the quality of simultaneous MBMS sessions might be limited. The WLAN access technology is capable of providing higher bandwidth but only in a smaller coverage area with limited mobility and QoS support. The integration of UMTS and WLAN networks offers a good chance for combining the advantages of the two access technologies. The cooperation of the wireless technology should also focus to the specific requirements set by the MBMS framework to use the radio resources most efficiently. Thus more sophisticated value added services based on MBMS structure can be offered over heterogeneous networks. This was our main motivation behind the work of creating a framework suitable for broadcasting and multicasting applications in integrated UMTS/WLAN architectures.

The rest of this chapter is organized as follows. In the next section a general overview of UMTS and WLAN systems is presented followed by the summary of their multicasting/broadcasting capabilities and a short introduction to the 3GPP-defined UMTS/WLAN interworking standards. After this overview our framework for MBMS service provisioning in WLAN segments of heterogeneous UMTS/WLAN systems is described and our MBMS-compatible WLAN

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