Chapter 18

Efficient Power Allocation in E–MBMS Enabled 4G Networks

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ABSTRACT

The plethora of mobile multimedia services that are expected to face high penetration, poses the need for the deployment of a resource economic scheme in Long Term Evolution (LTE) networks. To this direction, the Evolved - Multimedia Broadcast / Multicast Service (E-MBMS) is envisaged to play an instrumental role for LTE proliferation and set the basis for a successful 4th Generation (4G) standardization process. One of the most critical aspects of E-MBMS performance is the selection of the most efficient radio bearer, in terms of power consumption. This chapter presents the prevailing radio bearer selection mechanisms and examines their performance in terms of power consumption. Furthermore, it discusses problems regarding the high power requirements for the realization of E-MBMS and evaluates the proposed techniques/solutions. Finally, this chapter presents a novel mechanism for efficient power control during E-MBMS transmissions that conforms to LTE requirements for simultaneous provision of multiple multimedia sessions.

INTRODUCTION

Nowadays, mobile industry rapidly evolves towards a multimedia-oriented model for providing rich services, such as mobile TV and mobile streaming. Long Term Evolution (LTE) networks address this emerging trend, by shaping the future mobile landscape in a more power and spectral efficient way than its predecessors.

LTE technology improves spectral efficiency and sector capacity and lowers the telecommunication costs for service provision, making use of new and reformed spectrum opportunities and better integration with other open standards. These enhancements compared to Universal Mobile Telecommunication System (UMTS) technology, give LTE networks the
opportunity to offer high throughput, low latency, plug and play, improved end-user experience and simple architecture resulting in low operating expenditures.

More specific, LTE networks provide high peak rates of at least 100 Mbps in the downlink and 50 Mbps in the uplink. Contrary to UMTS networks that provide peak rates of 384 Kbps (or 21 Mbps with HSDPA) in the downlink, LTE networks may overcome the recent increase of mobile data usage and emergence of new applications such as mobile TV and streaming contents. However, the plethora of mobile multimedia services that are expected to face high penetration, poses the need for deploying complementary resource economic schemes.

To this direction, the Evolved - Multimedia Broadcast/Multicast Service (E-MBMS) is envisaged to play an instrumental role for the LTE proliferation in mobile market and set the basis for a successful 4th Generation (4G) standardization process. E-MBMS constitutes the evolutionary successor of MBMS, which was introduced in the Release 6 of UMTS (3rd Generation Partnership Project TR 23.846, 2003; 3rd Generation Partnership Project TS 22.146, 2008). It is a unidirectional service which targets at the resource economic delivery of multimedia data from a single source entity to multiple recipients. The main requirement during the provision of E-MBMS services is to make an efficient overall usage of radio and network resources and more importantly, to reduce the power requirements for the provision of such demanding services.

Power in mobile networks is the most limited resource and may lead to significant capacity decrease when misused. Providing multicast or broadcast services to a meaningful proportion of a cell coverage area may require significant amounts of power dedicated to the multicast or broadcast transmission. Several techniques, such as Dynamic Power Setting (DPS), Macro Diversity Combining (MDC) and Rate Splitting (RS) have been introduced in order to minimize the base station’s total E-MBMS transmission power. This chapter examines the operation and performance of these techniques and demonstrates the amount of power that could be saved through their employment.

Furthermore, a critical aspect of E-MBMS performance is the selection of the most efficient radio bearer, in terms of power consumption, for the transmission of multimedia traffic. The system should conceive and adapt to continuous changes that occur in such dynamic wireless environments and optimally allocate resources. The selection of the most efficient radio bearer is an open issue in today’s E-MBMS infrastructure and several mechanisms have been proposed to this direction. Nevertheless, the selection of the most appropriate mechanism is plagued with uncertainty, since each mechanism may provide specific advantages. In this chapter, the prevailing radio bearer selection mechanisms are presented and compared in terms of power consumption so as to highlight the advantages that each mechanism may provide.

Finally, this chapter presents a novel mechanism for efficient power control during E-MBMS transmissions that incorporates the advantages of each mechanism. The most remarkable advantage of the proposed mechanism, that actually differentiates it from the other approaches, is that it conforms to LTE requirements for the simultaneous provision of multiple multimedia sessions. This approach is compared with the aforementioned approaches in terms of both power consumption and complexity so as to highlight its enhancements and underline the necessity for its incorporation in E-MBMS specifications.

Main objective of this chapter is to present the main characteristics regarding the operation and performance of E-MBMS and moreover to highlight the significance of power control during E-MBMS transmissions. The reader will become familiar with the most crucial problems that have a direct impact on E-MBMS performance; and moreover, the reader will be introduced to the proposed techniques/solutions.
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