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Handover and New Call Admission Policy Optimization for G3G Systems

IOANNIS C. PANOUTSOPOULOS and STAVROS KOTSOPOULOS
Wireless Telecom. Lab., Department of Electrical and Computer Engineering, University of Patras, Rion 26500, Greece

VASILIOS TOUNTOPOULOS
Telecommunications Laboratory, Department of Electrical and Computer Engineering, National Technical University of Athens, Athens, Greece

Abstract. Handover blocking of ongoing calls due to the mobility of users is a quantity that determines at most the Quality of Service (QoS) in microcellular and picocellular G3G systems environments. In this paper we propose a call admission policy, based on the fractional guard channel scheme, which additionally considers the blocking of new calls. Simulation results show that the proposed policy gives an improved system performance, compared to the most commonly used handover algorithms.

Keywords: mobile communications, G3G, call admission, handover, queuing of blocked calls

1. Introduction

The future of mobile communications promise constantly increased subscriber number, which puts demand on more capacity in cellular networks around the world. This is especially true for GSM systems, which have been experiencing a tremendous growth rate for the last years and have become the leading cellular standard. The new coming third generation systems will be forced to hold high quality communications under heavy traffic conditions. The architecture of G3G systems will consist of an umbrella cell type, while the basic access methods to each cell will be W-CDMA and UWC-136 TDMA.

Handover is the mechanism that transfers an ongoing call from one cell to another as a user moves through the coverage area of a cellular system. As far as smaller cells are deployed to meet the demands for higher capacity, the number of cell boundary crossings increases. Since each handover requires from the network management to reroute the call to the new base station (BS), a decrease in the number of the expected handovers also decreases or minimizes the switching load. During the handover there is a brief service interruption. As the frequency of these interruption increases, the perceived QoS is reduced and the dropping probability of a call – due to factors such as the availability of channels – increases with the number of handover attempts. Hence, as the rate of the handover increases, new algorithms need to be developed in such a way that the perceived QoS does not generate and the cost to the cellular infrastructure does not skyrocket.

When the handover rate of the system increases, the probability of an ongoing call to be dropped due to a lack of free channel is high. Using a call-handling scheme that gives no priority to handover requests, both types of calls (new calls and handover calls) are treated in the same manner and the probability of a handover failure equals the probability of new call blocking. However, from the user's point of view, forced termination of an ongoing call is clearly less desirable than blocking of a new calling attempt. Handover prioritization schemes result in a decrease of handover failures and in an increase of new call blocking probability that, in turn, reduces the total admitted traffic. The concept of these strategies is to reserve a number of channels called guard channels exclusively for handovers [6]. It has been also shown in the literature that queuing is a very appropriate solution in order to minimize the handover or (and) the new call dropping probability. Hong and Rappaport [6] proposed and analyzed a priority queuing model, which gives the opportunity to handover calls to be queued if all channels in the target cell are busy. If any channel is released while the mobile is in the handoff area, the first call in the queue occupies this channel. Infinite queue size is here considered. Chang et al. [2] and Guerin [5] proposed queuing models for both types of calls. Queue sizes need not to be large in real applications due to call reneging and dropping. Another effective handover priority scheme is to assign free channels to new calls with a state-depended probability [9,10]. It has been shown that all the above handover priority schemes result in a better optimization for the forced termination probability and, on the other hand, in an increase of the new call blocking probability.

In the following section, a description of the traffic model and performance criteria assumed in this paper is given. Section 3 presents the fractional guard channel policy, as proposed in [9]. An alternative call admission policy, which uses the fractional guard channel policy and queuing of new calls, is introduced in section 4. The blocking probabilities and the average queue waiting times are here calculated by using Mason's rule. In section 5, the main handover policies are compared via a cost function. This function is a weighting sum of the new call blocking probability and the forced termination probability and indicates the importance of each of these probabilities to the system. Finally, section 6 presents the concluding remarks.