Area Residence Time Modeling in PCS Networks

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Abstract

The increasing demand for wireless cellular communications coupled with the limited available radio frequency has motivated investigation into alternative strategies of tracking terminals (users) and delivering calls. As a base work, it is essential to accurately analyze the signaling loads in real world systems: handoff and location update (LU) signaling loads. The frequencies of handoff and LU events depend upon the boundary crossing rates. Also, the crossing rates could be measured by residence time in corresponding areas. Furthermore, residence time analyses enable us to estimate the channel holding time and to evaluate many other performance measures in personal communications service (PCS) networks. All of these works, in fact, should be based on user mobility analysis to guarantee accuracy and to avoid impractical results due to assumptions.

Until now, various mobility models have been introduced. Most previous works does not consider random mobility patterns of users and different mobility classes simultaneously, which are considered in this work. There are two important reasons for considering the two factors in microcellular systems such as PCS networks.

Recent increase in wireless accesses leads the conventional macrocell systems to microcell systems in order to accommodate the increasing demands. As the cell size is smaller, the effect of user mobility on the system performances is more critical. It is because, none other than, the cell residence time is remarkably shortened. At the same time, handoff loads are also increased. Therefore, the previous approaches with simplifying assumptions are becoming invalid.

Second, different mobility users (i.e., high mobility users and low mobility users) bring about different loads on a system. Thus the two user sets should be served with different resource allocation mechanisms to guarantee better quality of service (QoS). Therefore, the two should be distinguished which motivates our work.

In this paper, user mobility is classified into two different classes: mobile user class (high mobility) and walking user class (low mobility). Also, we consider another characteristic of user mobility on probabilistic changes of moving speed and direction. Unlike previous works, irregular cell area patterns are also considered because the dwell time in a cell is sensitively dependent on the cell area pattern.

The contributions and results of this work are summarized as follows. Area residence time distribution in consideration of realistic mobility parameters is provided. With this, we can accurately estimate the handoff rates and LU rates.