Adaptive Location Update Schemes for Continuous Cell Zooming Algorithm in Wireless Networks

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Abstract — **Continuous cell zooming algorithm is a potential dynamic cell zooming algorithm for energy-efficient operation of mobile wireless networks. In this algorithm, location management strategy (location update process) is required to know the location of the farthest user in each cell to perform cell zooming. However, the application of conventional periodic update scheme in continuous cell zooming algorithm can lead to a high signaling cost. Therefore, in this paper, two adaptive location update schemes, namely, Time-Adaptive Periodic Update (TAPU) and Location-Adaptive Periodic Update (LAPU) are proposed aiming to reduce the number of update messages in continuous cell zooming operation. The performances of the proposed adaptive location update schemes are compared with that of Convention Periodic Update (CPU) scheme. Their performances are evaluated in terms of power saving capability, outage ratio and number of update messages raised in cell zooming operation in both omni-directional and sector-based cell networks. The TAPU and LAPU have no significant effect on power saving capability of continuous cell zooming algorithm and they give less number of update messages compared to CPU scheme. However, outage occurs in cell zooming operation with TAPU scheme because it has longer update intervals. Meanwhile the LAPU scheme can eliminate outage in cell zooming operation as CPU scheme does.**

Keywords— Adaptive location update; cell zooming; wireless network; signaling overhead

I. Introduction and Motivation

Cell zooming has been considered as one of the potential strategies for the development of 'Green' communication since it can optimize the power consumption in base stations which are the most energy-greedy components in a wireless network [1]. However, the challenges in dynamic cell zooming are how to reduce the effect of cell zooming on the quality of service (QoS) and how to reduce massive information exchange required when QoS is constrained. Therefore, a number of researchers have concerned with the issue of how to maintain QoS in a particular cell zooming algorithm while it is giving power saving [2]. These previous works stated that attention must be given on traffic spatial distribution to attain more efficient cell zooming and to maintain QoS at the same time [2]. Thus, two recent studies [3, 4] proposed and evaluated the state-of-the-art dynamic cell zooming algorithms; continuous zooming, fuzzy zooming and discrete zooming algorithms. For the sake of compactness, the detailed concept of each algorithm will not be mentioned here. These algorithms can be seen in [3, 4]. According to the results of these two studies [3, 4], it was found that the continuous cell zooming algorithm had the highest power saving capability compared to two other algorithms. In continuous cell zooming algorithm, the location of the farthest Mobile Station (MS) is firstly detected in each cell zooming period. Then, the transmitted power (transmission range) is shrunk to the exact location of the farthest user. For detecting the user location in continuous cell zooming algorithm, periodic location update method was used [4].

Here, the problem with periodic location update method is the outage (effect on QoS) due to the user mobility during a long update interval (cell zooming period) [4]. On one hand, the outage can be reduced by using very short periodic update interval. However, on the other hand, it will also lead to frequent and massive information exchange which results in signaling overhead because all users need to update at every update interval. In this regard, the aim of this work is to propose two possible adaptive periodic update schemes for continuous cell zooming algorithm in order to reduce the number of update messages while maintaining a small number of outage users.

The rest of this paper is organized as follows. The continuous cell zooming algorithm is briefly discussed in next section. Adaptive periodic update schemes are proposed in section III. The simulation models and parameters are mentioned in section IV. Then, section V describes the performance metrics. Then, section VI includes simulation results and discussion which is followed by conclusion.

II. Continuous Cell Zooming Algorithm

It is worth to briefly reintroduce continuous cell zooming algorithm here for sequential understanding. In Fig.1, BS denotes base station, MS represents mobile station, R_i is original cell radius and R_z is zoomed cell radius. In conventional operation (without cell zooming), the base station (BS) transmits power until it reaches the original cell edge regardless of traffic location. Indeed, it wastes extra energy if the user is not located at cell edge. Therefore, in the operation with continuous cell zooming, the farthest user location is firstly detected and the transmitted power is reduced until the convergence umbrella covers only a region in which the farthest user is included [3, 4].

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