行政院國家科學委員會專題研究計畫　成果報告

多個具相關性的 M/M/n/n, M/G/n/n 與 G/G/n/n 過程之研究與應用(2/2)

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計畫主持人：洪慧念

計畫參與人員：洪慧念 林資荃 陳沛君

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行政院國家科學委員會補助專題研究計畫成果報告

多個具相關性的 M/M/n/n, M/G/n/n 與 G/G/n/n 過程之研究與應用

計畫類別：■ 個別型計畫　　□ 整合型計畫
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執行單位：國立交通大學統計研究所

中　華　民　國　95　年　10　月　31　日

行政院國家科學委員會專題研究計畫期末報告

一、英文摘要

In a cellular tele communications network, the call blocking, forced termination, and call incompletion probabilities are major output measures of system performance. Most previous analytic studies assumed that the hand over traffic to a cell is a fixed-rate Poisson process. Such assumption may cause significant in accuracy in modeling. This project shows that the handover traffic to a cell depends on the work loads of the neighboring cells. Based on this observation, we derive the exacte quation for the hand over force-termination probability when the mobile station (MS) cell residence times are exponentially distributed. Then, we propose an approximate model with general MS cell residence time distributions. The results are compared with a previously proposed model. Our comparison study indicates that the new model can capture the handover behavior much better than the old one for small-scale cellular networks. Index

關鍵詞： Call duration time, cellular network, channel assignment, handover.

二、緣由與目的

Merging cellular telecommunications network technologies have attracted considerable attention in academic research as well as commercial deployment. A cellular network supports telephony services when users are in movement [10]. The cellular phone service area is populated with base stations (BS's). The radio coverage of a BS is referred to as a cell. Customers with in a cell can connect to the corresponding BS via mobile stations (MS's) or mobile phones. When a call for a customer occurs, one radio channel of the BS is used for connecting the MS and the BS. If all radio channels are in use when a new call is attempted, the call will be blocked and cleared from the system. If the call is accepted, a radio channel will be occupied until the call is completed, or until the MS moves out of the cell. When a communicating MS moves from one cell to another, the occupied channel in the old cell is released, and an idle channel is acquired in the new cell. During his hand over procedure, if no channel is available in the new cell, the call is forced to terminate before its completion. When the calls connected, the call maybe completed after several successful hand overs, or maybe forced to terminate due to a failed hand over. The duration of a call connection (if the call is completed) is referred to as the call duration time. For billing and network planning purposes, the hand over behavior and the probability of call completion need to be analyzed. Several analytic studies have contributed to cellular network performance evaluation [1], [3], [4], [6], [12], [13], [15], [17]. Most studies

assume that the hand over traffic to a cell is a fixed-rate Poisson process. This assumption is reasonable for large-scale cellular networks, or when the networks experience light load traffic [2]. In reality, the hand over traffic to a cell depends on the work loads of the neighboring cells. This fact has significant impact to modeling of small-scale cellular networks. We plot the call incompletion probability against the user mobility and the call arrival rate where the number of radio channels in a cellis 9. The curve is generated from a previous analytic model that assumes fixed-rate hand over traffic [12] . Another curve is generated from simulation 64-cell mesh configuration, and thethirs curve is generated from simulation of a three-cell configuration (illustrated in Figures). The simulation model [11] actually simulates the MS movement in meshor hexagonal networks of cells. This simulation model isused through out the paper. Figures indicate that the fixed-rate assumption is acceptable when the number of cells is reasonably large, but is inaccurate for small-scale cellular networks. In this project, we derive the exact equation for the hand over force termination probability when the MS cell residence times are exponentially distributed. Then, we propose an approximate model with general MS cell residence times. The results are compared with the previously proposed model [12]. Our comparison study indicates that the new model can capture the hand over behavior much better than the old one for small-scale cellular networks.

四、結論

Most analytic modeling studies for cellular networks assume that the hand over traffic to a cell is a fixed-rate Poisson process. This assumption may introduces ignificantin accuracy for modeling small-scale cellular networks. This project showed that the hand over traffic to a cell depends on the work loads of the neighboring cells. We derived the exact equation for the hand over force-termination probability when the MS cell residence times are exponentially distributed. Then we proposed an approximate model for general MS cell residence time distributions. The results are compared with a previously proposed model, which indicate that the new model can capture the hand over behavior much better than the old one for small-scale cellular networks.

四：自評

本報告的內容雖與計畫看似不相關。但事實上，在從事行動電話網路模型的計算中用到的都是有關 M/M/n/n, M/G/n/n 與 G/G/n/n 的理論與計算。因此，應算是本計畫的一個應用的成果。同時，在本計畫的支持下，除了本報告的內容外，也完成了一篇文章，以發表在Metrologia

(SCI)上，成果雖不算豐富，但也算是具有一定水準。

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