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Traffic Models and Performance Evaluation of Dynamic Channel Allocation of Severs for GSM/GPRS Network

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Abstract— **This paper aims to provide a dynamic resource allocation scheme for solving the problem of blocking probability and dropping probability in the case of GSM. For this purpose, a detailed traffic model for GSM is given. This research presents a performance model of a cell in a wireless network where the effect of handoff arrival and the use of guard channels are included. And this research proposes two analytical models of multidimensional rearrangement model and overflow Equivalent Random Theory (ERT) method to improve system performance of overflow cellular mobile network.**

Keywords— **ERT, Call Admission Control, Arrival Rate, Blocking Probability, Equivalent Random Traffic Method**

I. Introduction

In mobile cellular networks handover management has been one of the most important and challenging issues. It will become more significant in the near future since the current trends in cellular networks are to reduce cell size to accommodate more mobile hosts that will cause more frequent handovers, and to support not only voice traffic but also data and multimedia traffic such as video [1].

The next generation of wireless mobile networks promises to provide a wide variety of services such as voice; data, and multimedia to users on the move. Mobile customers can make a phone call as in wired telephony, to make a connection to retrieve information messages such as email or stock information. Because of the limited resources (time, frequency and code) of such networks, on going calls may be disrupted or dropped, which has a negative effect on customer satisfactions.

If the mobile moves to the coverage area of another BS, it does not finish its service in the originating cell and attempt to gain service in a neighbouring cell. This process is called handoff or handover [2]. In particular, in order to increase the system capacity, the cells sizes of the networks are reduced, and handover effect increased. Since users are more sensitive to handover dropping than to new call blocking, the channel assignment and handover priority is the important matter in cellular traffic planning.

Multidimensional traffic model is the generalization of classical traffic theory to cover several traffic streams offered to a single BS or trunk group. Each traffic stream may have individual parameters and may be state dependent or independent Poisson arrival process with multi slot traffic and class limitations. In communication networks with alternate traffic routing, the traffic which is lost from primary group is offered to an overflow group [3].

For the case of multi-class customers, the users enter to the system with different arrival. In this case, when the arrival rates of voice customer is increased, and then they fill up all the free channels and rejection rate of data customers is also increased. A possible solution to this would be divided to the total numbers of channels into parts and dedicated each part to the service of one customer type. This technique is called complete partitioning (CP) [4]. Complete partitioning is fairer than CS but the channel utilization is very low.

In wireless networks, mobile user may change cells a number of times during their call service time. In this case handover calls dropping should be as small as possible. It is preferable to block new call rather than block a call handed over from another cell due to user mobility. The available bandwidth is limited but it still needs to guarantee that a handover call will find enough bandwidth for its service. One strategy would be to reserve a number of channels for the service of handover call (Channel reservation) to reduce handover dropping probabilities [5].

Further Cellular network in host sport area of highly traffic demands will operate with many small cells, called microcells to increase capacity for services. These small micro cells are covered with microcell to serve overflow groups of channels for clusters of microcells [6].

One of the most accepted methods of dimensioning switches and trunks using alternative routing is the equivalent random Traffic (ERT) method. ERT has been successful tool for the analysis of overflow systems. ERT method is known to accurately approximate the blocking probability for systems with Poisson arrivals and negative exponential holding times [7].

II. PROPOSED SYSTEM MODEL

There are many assumptions in this model. They are:

(i) Handoff call has higher priority than new call.

(ii) If there is no available channel in the voice only server, the new call will be blocked.

(iii) The handoff call first serves, if there is idle channel in the voice only portion, if not, the handoff call can get channel in shared server. If all channels are busy then the handoff call will be blocked.

(iv) Short Message Service (SMS) share the data channels.

A. Overflow Traffic Model

The increasing demand in cellular network has forced the service provider to adjust system resources more efficiently. Layered cellular system achieves huge increase of available capacity. Microcell covers a small part of the service area and limited capacity. High teletraffic area covered by those microcells with overlying macrocells, which covers cluster of microcells and provide over flow group of channels for cluster of microcells.

The macrocell/microcell overlay architecture provides a balance between maximizing the number of users per unit area and minimizing the network control load associated with handoff [3]. Within overlay system environment, four types of handovers need to be managed: microcell to microcell, microcell to macrocell, macrocell to macrocell and macrocell to microcell. Overflow system with i primary cells (microcells) is shown in Fig. 1.

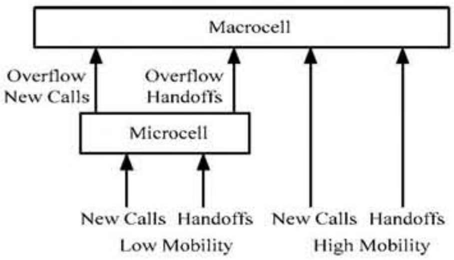

Fig. 1 Overflow system with primary cells

B. Rearrangement in Overflow System

A call using overflow server is buffered back to its own local server immediately when channel there become overflow [5]. For consider two traffic streams (X_1 and X_2) with offered traffic of (A_1 and A_2) each are served by own primary servers.

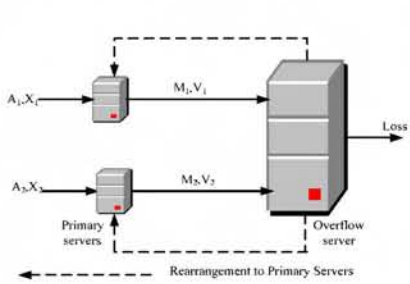

Fig. 2 Overflow system model in two traffic streams with rearrangement

The overflow traffic from each server is served by a common server group of with rearrangement method as shown in Fig. 2. In rearrangement method, the served channel in an overflow server is released it services to primary service group as soon as free channel available in primary servers.

III. PERFORMANCE EVALUATION OF DYNAMIC CHANNEL ALLOCATION OF SERVERS

This case study is to study performance evaluation of the system of each type of calls having limited capacity in primary servers and overflow shared servers. Numbers of channels in each server are used to be same the blocking probability of each type of calls in this study.

Table I shows the input parameters used in this section. In this study, we study the performance evaluation under different channel distribution.

They are:

(i) Channel distribution between voice only server and overflow server

(ii) Channel distribution between data only server and overflow (shared) server

But, in this paper, performance evaluation of channel distribution between voice only server and overflow server is described. In both cases, total capacities of channels in all servers remain the same.

TABLE I
INPUT PARAMETERS OF CASE STUDY

No.	Input Statements	Input Parameters
1	Mean departure rate for New calls	1 calls/min
2	Mean departure rate for Handoff calls	3 calls/min
3	Mean departure rate for SMS	10 calls/min
4	Mean inter arrival rate of New calls	0.1 calls/min
5	Mean inter arrival rate of Handoff calls	1.5 calls/min
6	Mean inter arrival rate of SMS	1 calls/min
7	The number of channels in voice only server	11 to 2 channels
8	The number of channels in data only server	13 to 12 channels
9	The number of channels in shared server	11 to 2 channels
10	Bandwidth usage for each type of call	1 channel/call

(i) Channel distribution between voice only server and shared server

Fig. 3 and Fig. 4 show the blocking probability of each call under constant channels for data only server, decreasing channels for voice only servers and increasing channels for shared servers.

In these figures, R is rearrangement, A is analytical (Erlang), S is simulation and O is overflow.

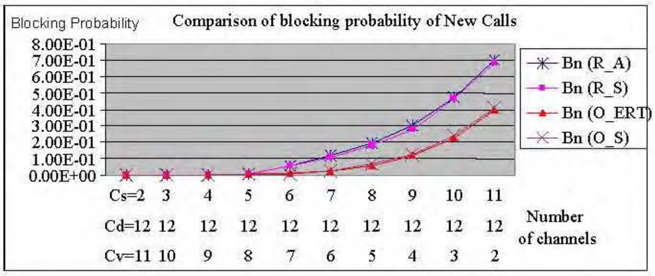

Fig. 3 Blocking Probability of New Calls under Channel Distribution of Servers.

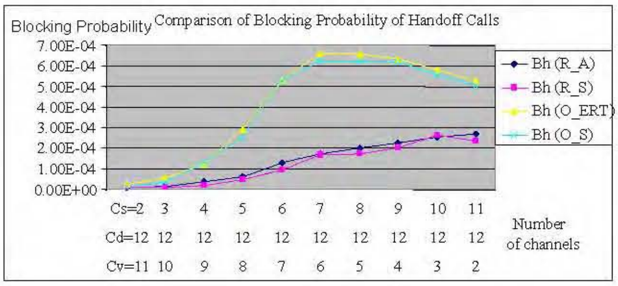

Fig. 4 Blocking Probability of Handoff Calls under Channel Distribution of Servers

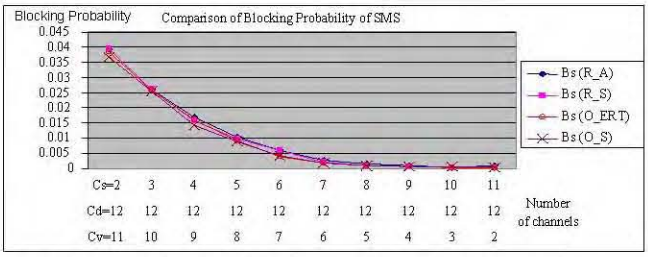

Fig. 5 Blocking Probability of SMS under Channel Distribution of Servers

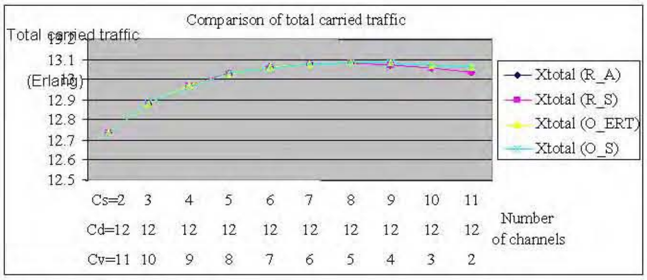

Fig. 6 Total Carried Traffic under Channel Distribution of Servers

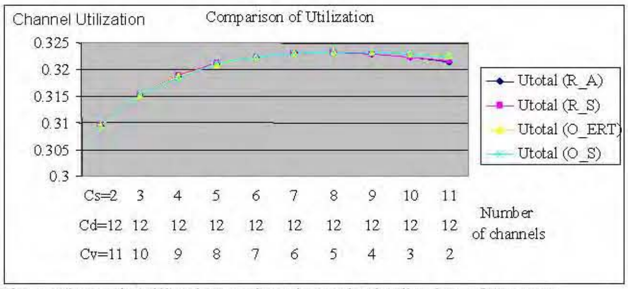

Fig. 7 Channel Utilization under Channel Distribution of Servers

V. DISCUSSION

The results shown in Fig. 3 and Fig. 4 are the blocking probabilities of new calls and handoff calls under channel distribution of servers. These results show that the blocking probability of new calls increases when the channels in local server decrease. To get the same blocking probability of new calls in rearrangement and overflow, the channels in voice only servers is larger than 6 channels.

The blocking probability of handoff calls increase under increasing channels in shared servers and decreasing channels in voice only server. Blocking probability of handoff calls in rearrangement model is less than that in overflow model. When number of channels in local and shared server are [7, 12, 6], the different blocking probability in two models is maximum. To get the same blocking probability of two models, the channels in local server is larger than 11 channels.

Fig. 5 shows the blocking probability of SMS under channel distribution of servers. The results shown in Fig.5 decrease when capacity of shared server increasing and the values in two models are the same.

Fig. 6 shows the total carried traffic under channel distribution in server. The results shown in Fig. 6 increase under decreasing channels in voice only server and increasing channels in shared server, and total carried traffic in two models are same at channels less than 8 channels. Fig. 7 shows the channels utilization of the system under channels distribution of servers. When the channels in shared server increase, channels utilization of the system is good. At channels [8, 12, 5] and [9, 12, 4], channel utilization is maximum.

From the results of Fig. 4 to Fig. 7 it can be concluded that blocking probability of new calls and handoff calls increase under decreasing channels in voice only server and capacity in shared server.

The blocking probability of new calls in rearrangement model is greater than that of overflow model. So the total carried traffic of new calls increases in overflow model. From Fig. 3, news calls get good performance at channel series less than [5, 12, 8].

The blocking probabilities of handoff calls are smaller in rearrangement model than that of overflow model. So the total carried traffic of handoff call increases in rearrangement model because the overflow calls in shared server are rearranged down to primary servers when channel becomes available in primary servers. So it has more chance to occupy more channels for handoff calls. So the service is the best for channel series [7, 12, 6] and [8, 12, 5].

V. CONCULSION

This research work has developed to carry out the performance evaluation of overflow cellular mobile telephones by using rearrangement (Erlang B) and overflow (Equivalent Random Traffic (ERT)) methods. In this research, simulation model is used to evaluate performance evaluation of the system for rearrangement and overflow models. This simulation model was constructed by Monte Carlo simulation methods.

This method is a numerical method for generating random numbers to perform the simulation. Both single bandwidth and multi-bandwidth in rearrangement and overflow models have been calculated by using Monte Carlo simulation method. The application software has been developed by using C programming.

The simulation results show that the rearrangement scheme improves the system performance from the comparison of blocking probability in rearrangement method and overflow methods. Especially, the blocking probability of SMS decreases. But the blocking probabilities in local server increased. Total blocking probabilities of the overflow calls decrease under large capacity of shared server. Total carried traffic in shared server and that of the system by using rearrangement method are more than by using overflow method. In addition, the rearrangement method decreases the blocking probability of multi-bandwidth traffic in SMS calls. The increasing channel capacities in shared server improve the blocking probabilities of all calls, especially for overflow calls.

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