An Intelligent Channel Allocation Mechanism

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Abstract. Channel allocation algorithms can be classified into three methods. This paper is based on the fixed method. We propose a new fixed channel allocation mechanism using genetic algorithm in cellular mobile computing environments. Our simulation result indicates that the proposed algorithm could reduce a search time for an available channel.

Keywords: Channel Allocation, Cellular Environment, Genetic Algorithm.

1 Introduction

The concept of cellular architecture is generally conceived as a collection of geometric areas [1], called cells (typically hexagonal-shaped). Each served by a Base Station (BS) located at its center. A number of cells (or BS) are again linked to a mobile switching center (MSC). A BS communicates with the mobile users through wireless links, and with the MSC's through wired links. The frequency channels are a scarce resource in a cellular mobile system. Thus, many schemes have been proposed to assign frequencies to the cells such that the available spectrum is efficiently used, thus the frequency reuse is maximized. They can be classified into three – fixed[1, 2, 3], dynamic[3, 4, 5], flexible[3] – methods. This paper is based on the fixed method.

In a fixed assignment(FA) scheme, a set of channels is permanently allocated to each cell, which can be reused in an another cell, sufficiently distant, so that co-channel interference is tolerable. The advantage of a FA scheme is its simplicity. But the disadvantage is that if the number of calls exceeds the number of channels assigned to a cell, the excess calls are blocked. This problem can be partially alleviated by a channel borrowing method[6]. In the channel borrowing method, a channel is borrowed from a suitable one of the neighboring cells in case of blocked calls provided that it does not interfere with the existing calls. The disadvantage of channel borrowing is that the BS's communicate with each other to decide a suitable cell to lend a channel until a suitable channel will be searched.

We propose a genetic algorithm approach for channel allocation to improve above-mentioned problems.

2 Proposed Algorithm

Channel allocation in cellular mobile computing environments means a channel borrowing from a cold cell to meet a service request of a hot cell. So, it needs a measure to decide a cell whether a cell received a service request is a hot or a cold. A load measure used in this paper uses the following equation.

$$DC_i = \frac{NAC}{NTC}. \quad (1)$$

A NTC is the number of total channels in each cell. A NAC is the number of available channels in each cell. The channel migration policy uses the threshold policy that makes decisions based on DC_i. The migration policy is triggered when a service request arrives at a cell. This paper uses two thresholds(T_{low}, T_{up}) to decide whether the cell is a hot or a cold. A cell identifies as a suitable cold cell for a channel acquisition if the cell's DC_i will not cause to exceed T_{low}. The BS in the cell performs a load redistribution based on genetic algorithm to borrow a channel from cold cell if the cell is hot. The algorithm is performed in its BS when a call enters a cell.

Each cell in cellular mobile computing systems has its own population which genetic operators are applied to. There are many coding methods. We use the binary coding method. Therefore, a chromosome in a population can be defined as a binary-coded vector which indicates a set of cells to which the request messages are sent off. If the request message is transferred to the cell c_i (where $0 \leq i \leq n-1$, n is the total number of cells in mobile system), then v_i is 1, otherwise v_i is 0.

Each chromosome involved in a population is evaluated by the following equation.

$$F = \frac{1}{NMSG+DS+DC_i}. \quad (2)$$

A *NMSG* means the number of messages communicated between BSs to find a cold cell. *DS* means a distance from the current cell to a searched cold cell. DC_i means a degree of load for a cell.

A load redistribution approach using genetic algorithm in cellular mobile system consists of five modules. A Genetic_operation module consists of three sub-modules. These modules are executed at each BS in cellular mobile system.

In an Initialize(), a population of chromosomes is randomly generated without duplication. A Check_load() is used to observe its own cell's load by checking the DC_i whenever a call is arrived in a cell. If the observed load is a hot, the load redistribution activity performs the following modules. A Chromosome_evaluation() calculates fitness value of chromosomes in the population. A Genetic_operation() is executed on the population in such a way as follows. The following Genetic_operation() is applied to each chromosome, and new population of chromosome is generated:

In mutation(), a chromosome 1 is chosen. A copy version of the chromosome 1 is generated, and it is mutated. This new chromosome is evaluated by the fitness function. If the evaluated value of the new chromosome is higher than that of the original chromosome, it is replaced the original chromosome with the new chromosome. Next, the second chromosome is chosen. And above-mentioned mutation operation is done. This operation is applied to all chromosomes in the population.

In reproduction(), a reproduction operation is applied to the newly generated chromosomes. We use the "wheel of fortune" technique.

In crossover(), crossover operation is applied to the newly generated chromosomes. These newly generated chromosomes are evaluated. We applied to the one-point crossover operator.

The Genetic_operation() selects a chromosome from the population at the probability proportional to its fitness value, and then sends off the request messages according to the contents of the selected chromosome. A Message_evaluation() is used whenever a cell receives a message from a different cell. When a cell c_i receives a message, it sends back an accept or reject message depending on its DC_i.

3 Simulations

Our simulations have the following assumptions. Firstly, the load rating over systems is about 90 percent. Secondly, a number of channels in each cell are 25. And there are 50 cells in cellular mobile computing system. In genetic algorithm, the crossover probability(p_c) and mutation probability(p_m) are 0.7 and 0.1. A number of calls to be served are 5000. These values in p_c and p_m were known as the most suitable values in various applications[7, 8, 9]. This simulation is to observe a search time for a suitable cell to lend a channel when the number of calls to be served is 5000.

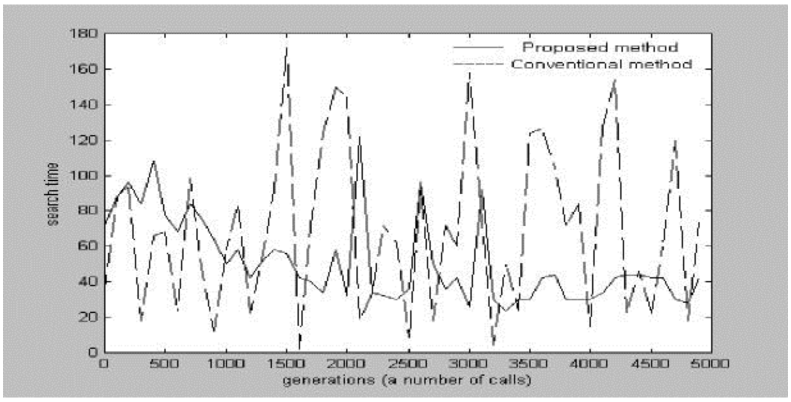

Fig. 1. Result

4 Conclusions

We propose a new fixed channel allocation mechanism. The purpose of using genetic algorithm in this paper is to decrease search time for an available channel and is to migrate from a searched channel to a hot cell. The channel request messages are sent off to the cells in accordance with the contents of a chromosome.

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