Enhancement of QoS in Mobile Network through Channel Allocation using Software Agents

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Abstract
In the last two decades the demand for mobile hosts is increasing rapidly. One of the biggest challenges in cellular systems is to fulfill the mobile user demand under the constraint of the limited spectrum. Some of the most common methods to increase the channel allocation and utilization are resource allocation schemes. Various channel allocation schemes have been proposed to provide Quality of Service (QoS) and efficient channel utilization in cellular networks. This paper proposes architecture of Multi-agent system consisting of software agents to implement distributed dynamic channel allocation strategy. The strategy is based on the channel reassignment within the cell boundary and chained channel borrowing in neighboring cell areas. The QoS parameters analyzed are Call dropping probability and Call blocking probability.

Keywords: Channel Allocation, QoS, Multi agent system, FCA, DCA.

1. Introduction

1.1 Architecture of Cellular Network

A cellular network[1],[3] is a radio network distributed over land areas called cells, each served by at least one fixed-location transceiver known as a cell site or base station. When joined together these cells provide radio coverage over a wide geographic area. This enables a large number of portable transceivers (e.g., mobile phones, pagers, etc.) to communicate with each other and with fixed transceivers and telephones anywhere in the network, via base stations, even if some of the transceivers are moving through more than one cell during transmission. An overall cellular network contains a number of different elements from the base transceiver station (BTS) itself with its antenna back through a base station controller (BSC), and a mobile switching centre (MSC) to the location registers (HLR and VLR) and the link to the public switched telephone network (PSTN).

Another important aspect of cellular telephony is unlimited mobility. The user can be anywhere within the coverage area of the network, in order to be able to communicate. The cellular network interfaces with the PSTN, as well as with other wireless systems.

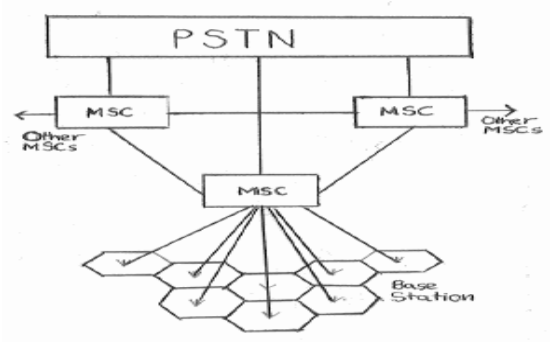

Fig. 1 Architecture of Cellular Network

1.2 Cellular concept

In cellular system [5], each cell is characterized by one base station which serves the users within that geographical area. Inter-cell

connections are possible with a fixed network which connects different base stations. Network is having scarce radio resources and no. of users are increasing every day. The tremendous growth of usage of mobile network has increased the need for better admission control strategies and efficient utilization of resources such as bandwidth, to provide a better Quality of Service (QoS).

1.3 Handover:

A handover (or handoff) [2] refers to a situation where all radio resources of a connection are handed to another base station because of cell change. In cellular telecommunications, the term handover or handoff refers to the process of transferring an ongoing call or data session from one channel connected to the core network to another. In satellite communications, it is the process of transferring satellite control responsibility from one earth station to another without loss or interruption of service. Hand over can be either soft handover and hard handover.

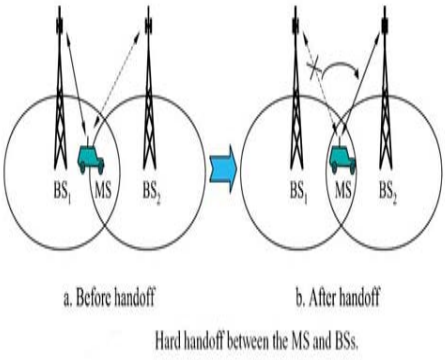

Fig 2. Hard Handoff

1.4 Channel allocation

The process of channel allocation is to allocate channels to the various cells so that the available bandwidth is most effectively used by the various cells to meet the traffic demand in each cell without interfering with calls in neighboring cells.
There are two strategies:

1.4.1 Fixed Channel Allocation (FCA): With FCA, a set of channels is permanently assigned to each cell, according to the allowed reuse distance D. A call can only be served by an available channel belonging to the poll of channels of the cell. A call arriving in a cell, where no channel is available, is blocked and cleared.

1.4.2 Dynamic Channel Allocation (DCA): DCA allows that any system channel can be temporarily assigned to any cell, provided that the reuse distance constraint is fulfilled. Different DCA techniques can be considered depending on the criterion adopted to select a channel to be assigned in a cell among all available resources.

2. Multi agent system Model

Multi Agent System [6] extends the intelligent agent paradigm to improve upon the conceptual model of designing problems through agent interaction. [7] discusses performance Evaluation of Multi Agent Based Call Admission in Cellular Networks. Call admission control (CAC) [10, 11] is a fundamental mechanism used for quality of service (QoS) provisioning in a network by limiting the number of call connections into the networks in order guarantee Connection level QoS parameters such as new call blocking probability and handoff blocking probability, packet level QoS parameters such as delay, jitter, packet loss for various classes of traffic and mobility QoS parameters such as velocity, distance and direction of the movement of mobile terminal.

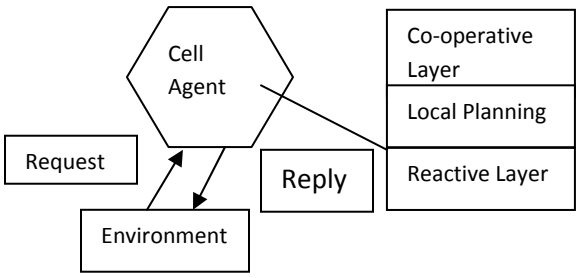

Fig. 3. Multi Agent System Model

The Layered architecture of the above model consists of three layers. The functions of these layers are as follows:

Reactive Layer gives fast response to the request and local allocation; Local Planning Layer work for distributed dynamic channel allocation using channel reassignment and channel borrowing and Co-operative Layer takes care of global scenario and balance the ratio of hot cell and cold cell.

In the design of a cellular mobile communication system, a region is divided into a series of cells, each one covered by a base station. Each station can also have more than one transmitter– receiver (also called a transceiver or simply transmitter). Each transmitter works at a certain frequency and the same frequency can be used in different cells (allowing a reduction in the number of base stations required and in the overall cost of the installation). However, the reuse of the same frequency in different cells is limited by the maximum tolerable interference between cells. This paper implements distributed dynamic channel allocation strategy using a multi-agent system virtually ported at Base station [8],[9]. The agents here are software agents, represent network operators that manage the radio resource of different regions of the cellular network. The extra dimension in a wireless network is the allocation of channel to a cell to avoid interference and avoid degradation in QoS.

3. Algorithm

There have been several Algorithms for our system is implemented as follows:

1. Initialization: The Input request will come to Base station will be handled by Reactive Layer of multi agent system of base station.

2. Execution: For every New Request at the initial state, Reactive Layer is allocating a channel from local set of allocated channel if there is free channel. If channel is not free, request is transferred to Local Planning Layer.

Consider a call is originated in Cell no. 4, if there is no channel available in Cell 4, request will be given to borrow a channel to Co-channel Cell 10, if Cell 10 is not having free channel, request is further transferred to Cell 13 and so on. Request is scanned by all co-channel cells in chain till the free channel is available. This is chained channel reorganization. Suppose channels 1–5 are occupied in a cell 4 and the call occupying channel 2 terminates – then the call using channel 5 is reassigned to channel 2. This ensures that the lowest ordered channels are always used first and highest ordered channel will be free to maintain threshold. Threshold is constant value of a parameter in algorithm. Threshold represents minimum. Number of channels reserved to avoid channel starvation in cell. The degree of dynamism of the algorithm can be varied by changing the value of threshold. Keeping highest ordered channels free for crisis, is known as highest order availability (HOA) algorithm.

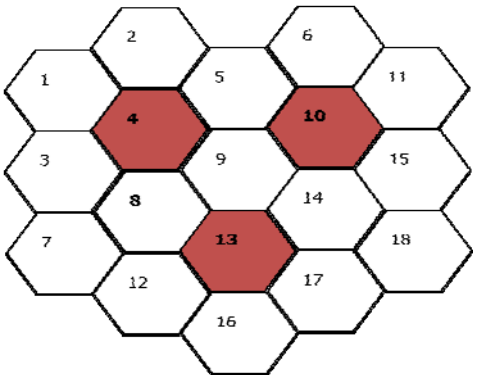

Fig.4 Hexagonal software Model of Cellular Network

4. Simulation & Results (Using OMNET++)

In this work, we do not consider users mobility and their precedence. OMNET++ is an object-oriented modular discrete event network simulator. We adopted following parameter values for performing simulations:

1. Cluster Size K = 3
2. 70 channels totally available to the system
3. Call inter arrival time: 10 sec.
4. Call duration: 3min.
5. No. of calls handled per sec by Base Station : 1.5 times no. of clients
6. Negotiation tenure: 5 secs.
7. Threshold limit 0.2% of total no. channels allocated to cell

4.1 Enhancement in QoS

We measured the percentage of channel requests that are dropped/ denied because the algorithm cannot allocate any channel in response to such requests.

Channel request load is approximation of percentage of channel allocated to a cell.

Percentage of Call dropping			
DDCA using spatial distribution		**DDCA using Software agent (chained channel reorganization)**	
Channel req. Load	**Call dropping prob. Perc.**	**Channel Req. Load**	**Call dropping prob.**
20%	**0**	**20%**	**0**
30%	**0**	**30%**	**0**
40%	**0**	**40%**	**0**
50%	**0.5**	**50%**	**0**
70%	**6**	**70%**	**4**
90%	**13**	**90%**	**10**
100%	**18**	**100%**	**16.5**

Table 1: Call dropping Percentage

5. Conclusion

A flexible scheme using intelligent agents is proposed. The agent architecture adopted is able to provide greater autonomy to the base stations and allows co-operation and negotiation among them. The layered architecture will also support parallelism. The simulation demonstrates the improvement in QoS Parameters.

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