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Bandwidth Allocation for Wireless Data Dissemination in Multi-Cell Environments Using Optimization Techniques

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ABSTRACT

Effective data management and resource management are vital to the success of emerging mobile data applications. the allocation of resources such as Bandwidth, buffer in mobile cellular networks becomes an increasingly important issue. In addition, varying mobility and various service class requirements of the present multimedia applications makes it a challenging one. It is mostly realized in the present Third generation (3G) and beyond 3G (B3G) mobile network system. Hence an effective and efficient utilization of resources such as bandwidth in mobile cellular system using better optimization schemes are needed. This paper investigates the problem of bandwidth allocation for data dissemination in a multicell environment. The performance objective is to minimize the overall expected access latency also addresses the critical issues of resource allocation - in particular about optimization of bandwidth with adaptive Quality of Service (QoS) requirements. In order to have optimized bandwidth applications, optimization schemes- Linear Programming (LP).LP methods solve optimization problem having linear objective function and constraints.

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I. INTRODUCTION

Due to resource limitations in a mobile environment, effective data management and resource management are vital to the success of emerging mobile data applications. There are two fundamental delivery methods for wireless data dissemination.

On-Demand Access: A client sends data requests uplink to the server, and the server returns the results to the client individually.
Data Broadcast: The server periodically broadcasts information to the entire client population, and the clients monitor the broadcast channel to retrieve the data of their interest.

A lot of work has been done on bandwidth allocation for data dissemination in order to achieve a better access performance [l, 3, 4, 61**.** For data broadcast, [l, 3] proposed methods in which more bandwidth is assigned to frequently accessed items and less to infrequently accessed items such that the overall access latency is optimized. In [2, 41, a hybrid system is suggested to combine on-demand and broadcast based data dissemination. The bandwidth allocation between on-demand access and data broadcast was analyzed in [4],.Unfortunately, these studies are confined to single-cell environments. In a multi-cell environment, such as a cellular network, bandwidth allocation becomes much more complex than that of a single-cell environment. This is because neighboring cells in a cellular network are not allowed to use the same frequencies for communication simultaneously because of signal interference [8]. As such, the available bandwidth for a system is shared by a group of neighboring cells. On the other hand, if two cells are apart sufficiently, the same frequencies can be reused in these two cells. As a result, bandwidth allocation cannot be considered on a cell-by-cell basis. Thus, the allocation of frequencies/bandwidth to each cell so as to achieve better balance among the cells is a challenging task. Although channel allocation for multi-cell voice communications has been extensively explored these studies aim at minimizing call blocking/ dropping probabilities or improving carried traffic while ensuring certain level of QoS requirement. On the other hand, the characteristics of mobile data applications, which are mostly concerned with access latency, are not considered at all.

In the past few years, tremendous growth of mobile network technology has increased the demand for effective and efficient utilization of resources such as band width with QoS guarantee. Also the mobile networks supporting data and real time multimedia with different traffic requirements, providing better QoS, is a challenging task. In comparison to data applications such as e-mail and web applications, real time applications need stringent QoS. Apart from this, real time applications such as voice should not suffer call dropping during hand off and call blocking in case of new connection calls within a cell. Most of the bandwidth allocation schemes existing, deals with minimization of call blocking and call dropping probabilities. Thus probability of hand off dropping becomes an important QoS metrics in wireless networks [6]. A number of Admission control and bandwidth adaptation techniques exist in the literature. The hand-off bandwidth estimation dealt by [7] [8] mainly focus on reserved bandwidth. The shadow cluster concept proposed by Levine [9] et al deals with proposed predictive resource allocation wherein Mobile Station (MS) informs Base Station (BS) within adjacent cells about the bandwidth needed during call setup time. Through this the BS predicts its future demands. But it has the drawback of large overhead. For QoS metrics such as throughput, delay in multimedia environment, priority based admission control is proposed in [10]. The better utilization of network bandwidth using measurement based admission control is proposed in [11]. In [12], adaptive band width reservation was used. By this method, if reservation fails, new hand off connections is rejected. The major drawback of this scheme is the minimization of the band width utilization, the prime need of real time multimedia applications which possess lower bound and upper bound on network resources for any typical applications. In the fair resource protocol uses both bandwidth reservation and bandwidth probabilities. It is applicable to max-min fairness protocol . Also the fair resource allocation protocol compared with which use a proportional fairness so as to tolerate transient fluctuations using bandwidth borrowing concept. But all the schemes used above do not deal with optimized bandwidth allocation. But the paper addresses the issue of LP based resource reduction using Artificial Neural Networks (ANN) model.

This paper investigates the problem of bandwidth allocation for wireless data dissemination in a multicell environment. As the first step, in this paper we study this bandwidth allocation problem for a cell cluster within which frequencies are not reused. The objective is to find out the optimal bandwidth allocation scheme which minimizes the overall data access latency. Optimal allocation technique is developed to effectively allocate bandwidth among a cell cluster. The aim of optimization strategy is to maximize the effective bandwidth utilization for different service classes. In this article we provide performance evaluation of resource allocation using two optimization techniques namely LP

II. OPTIMIZATION TECHNIQUES

Optimization techniques are becoming increasingly popular in engineering due to the availability of high speed computers. These are used in engineering optimization problem which contain multiple optimum solutions with one or more absolute minimum or maximum solutions. The optimization algorithm starts with formulation of optimization problem. It begins with identifying important design variables that can be changed in a design.

III.SYSTEM MODEL

A mobile multimedia wireless cellular system with cells of hexagonal shape is considered. For symmetry, a model of target cell surrounded by six neighboring cell is assumed. Each cell is having a base station (BS) which allocates and reserve bandwidth for mobile stations (MS). The MS communicate with their home BS's via the air interface and number of BS's are connected to a Mobile Switching Center (MSC) which in turn connected to the backbone wire line networks. The bandwidth can be shared for 03 types of applications namely Running, Hand off and New applications. Let us assume the already scheduled applications as running applications. The calls from MS moving from adjacent cell to the target cell is termed as hand off applications, while new calls coming from the same target cell being termed as new calls applications. The network service provider has to provide a sufficient bandwidth for handoff calls and new calls. For this the bandwidth from running applications has to be utilized optimally without degradation in QoS. The handoff connection or call dropping probability (CDP) is the dropping of the hand off call when there is insufficient bandwidth. A new call with denied access into the network is called as new call blocking probability CBP. These are the major QoS parameters in a multimedia wireless networks. From end user perspective the call blocking is more acceptable than call dropping [8]. So the optimum design in dynamic bandwidth adjustment is such that CDP of handoff calls can be minimized and CBP of new calls should be maintained at an acceptable level. The multimedia applications can be classified into real time and non-real applications. The real time applications are time sensitive applications with tight constraint on delay and delay variation. Also real – time applications have strict QoS requirements and negotiates its QoS such as minimum delay, delay variation etc during call set up with the network. Examples for real time applications are compressed voice and video, compressed voice with silence suppressions and standard digitized voice at 64 Kbps. The non-real time applications are time insensitive applications

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but with tight constraint on information loss. These data applications require reliable transport but not real-time transport of information through the network. So these data applications are more tolerant to delay as compared to real-time applications. The naval Dynamic Call Admission Control (DCAC) scheme maximizes
Wireless channel utilization with respect to bound on call dropping and packet loss probability for VBR. .

Due to diverse QoS requirements and various traffic descriptors, it is mandatory to design a suitable network system accorded with different priorities and optimized resource requirements, without much degradation in QoS

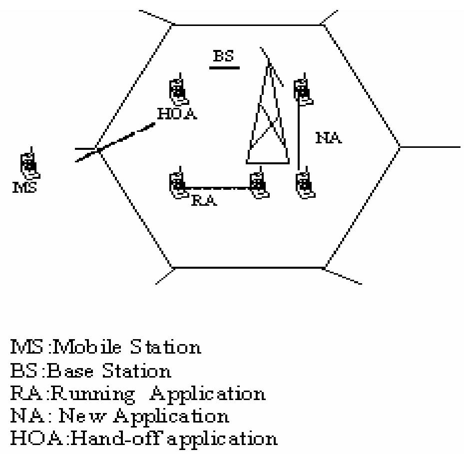

Fig 1.Cell Network Model

IV. OPTIMALRESOURCE ALLOCATION USING LP

Effective and efficient resource allocation is essential for cellular mobile network system that supports various applications. The objective of resource allocation is to decide how to allocate resources such as maximization of bandwidth meeting the QoS requirements for all the applications. In general, multimedia connection has several service classes, each of which presents a range of feasible QoS levels (e.g., data rates). The principle used in is mainly devoted to admission control by maintaining QoS guarantee to existing applications and to increase the percentage of admission to real time and nonreal time application using LP based resource reduction method. The LP-Resource Reduction minimizes the allocated bandwidth of already scheduled applications without degradation in QoS. It is helpful in obtaining a large quantity of available resources for scheduling the remaining hand-off and new applications. The LP method for given problem is given as below.

$$\text{Maximize} \quad \sum_{i=1}^{r} C_i R_i \qquad (1)$$

$$\text{Subject to} \sum_{i=1}^{r} R_i \le (1-\Omega)(P-\Theta) \qquad (2)$$

$$R_i^{min} \le R_i \le R_i^{alloc} \qquad (3)$$

$$R_i \ge 0, \forall i \in [1, r] \qquad (4)$$

Where R_i is the decision variable to be solved to provide new bandwidth for running applications on solving above problem. C_i is the weight chosen for minimum and maximum requirement. Ω is the reduction parameter and P is the maximum bandwidth and Θ is the remaining bandwidth. Note that each application has its own rate and thereby for different running application(r) optimum bandwidth requirement is changed accordingly. The LP reduction has been done using Simplex algorithm as proposed in .

V. CONCLUSION

Bandwidth allocation for wireless data dissemination in a multi-cell mobile network has been limited in the literature. With the booming of mobile data applications, it is believed that this bandwidth allocation problem is becoming more and more important. This paper has formulated the bandwidth allocation problem for a cell cluster, with the objective of minimizing the overall expected data access latency. Optimal allocation technique LP has been analyzed.

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