A Novel Distributed Call Admission Control for Wireless Mobile Multimedia Networks

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ABSTRACT

This paper introduces a novel distributed call admission control framework developed for cellular mobile networks. The main feature of the proposed framework is a more efficient support for mobile multimedia users having dynamic bandwidth requirements. This is achieved by reducing the call dropping probability while maintaining a high network resource utilization. A call admission control algorithm is proposed in this paper and involves not only the original cell (handling the new admission request) but also a cluster of neighboring cells. The neighboring cells provide significant information about their ability to support the new mobile user in the future. This distributed process allows the original cell to make a more clear-sighted admission decision for the new user. Simulations are provided to show the improvements obtained using our framework.

Keywords

Wireless mobile networks, multimedia traffic, call admission control

1. INTRODUCTION

Cellular mobile networks have to continue supporting their mobile users after they leave their original cells. This poses a new challenge to Call Admission Control (CAC) algorithms. A call admission process should not only take into consideration the available resources in the original cell but also in neighboring cells as well. Mobile users are in a growing demand for multimedia applications, and the next generation wireless networks are designed to support such bandwidth greedy applications. The (wireless) bandwidth allocated to a user will not be fixed for the lifetime of the connection as in traditional wireless networks, rather the base station will allocate bandwidth dynamically to users. The Wireless ATM and the UMTS standards have proposed solutions to support such capability.

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Several call admission algorithms have been proposed for wireless networks (e.g. [2]) to support multimedia users with dynamic bandwidth requirements. These algorithms take only local information in the admission decision process, and therefore will have a high call dropping probability. Call dropping probability is an important connection level QoS parameter in wireless mobile networks. To reduce the call dropping probability, few other CAC algorithms which take into consideration neighboring cells information have been proposed [6, 1, 7]. However, those algorithms only support users with fixed bandwidth requirements.

To our knowledge, no call admission control algorithm has been proposed for supporting multimedia users with dynamic bandwidth requirements while offering a low call dropping probability. To achieve this goal, we propose a novel Distributed Call Admission Control framework designed for wireless mobile multimedia networks.

The call admission process involves not only the cell that receives the call admission request but also a cluster of neighboring cells so the user will not be dropped due to handoffs. Consequently, the network will provide a low call dropping probability while maintaining a high resource utilization.

The paper is organized as follows. In section 2, we describe the model of the system considered in this paper. Section 3 defines the dynamic mobile probabilities used by our distributed call admission control algorithm. In section 4 we present the call admission control performed locally by the cells in our system. Section 5 introduces the overall call admission control scheme involving a cluster of neighboring cells. Section 6 gives the detailed steps of the distributed call admission control algorithm. Section 7 discusses the conducted simulation parameters and results. Finally, section 8 concludes this paper.

2. SYSTEM MODEL

We consider a wireless/mobile network with a cellular infrastructure that can support mobile terminals running applications which demand a wide range of resources. Users can freely roam the network and experience a large number of handoffs during a typical connection. We assume that users have a dynamic bandwidth requirement. The wireless network must provide the requested level of service even if the user moves to an adjacent cell. A handoff could fail due to insufficient bandwidth in the new cell, and in such case, the connection is dropped.

To reduce the call dropping probability, we propose to make neighboring cells participate in the decision of a new user admission. Each involved cell will give its local decision and finally the cell where the request was issued will decide if the new request is accepted or not. By doing so, the new admitted connection will have more chances to survive after experiencing handoffs.

We use the notion of a cluster similar to the shadow cluster concept [5]. The idea is that every connection exerts an influence upon neighboring base stations. As the mobile terminal travels to other cells, the region of influence also moves. The set of cells influenced by a connection are said to constitute a cluster (see figure 1). Each user in the network, with an active connection has a cluster associated to it (in the rest of the paper the term "user" and "connection" are used interchangeably). The cells in the cluster are chosen by the cell where the user resides. The shape and the number of cells of a user's cluster depend on factors such as user's current call holding time, user's QoS, terminal trajectory and velocity.

3. DYNAMIC MOBILE PROBABILITIES

We consider a wireless network where the time is divided into equal intervals at $t = t_1, t_2, ..., t_m$. Let j denote a base station in the network, and x a mobile terminal with an active wireless connection. Let $K(x)$ denote the set of cells that form the cluster for the active mobile terminal x. We denote $P_{x,j,k}(t) = [P_{x,j,k}(t_0), P_{x,j,k}(t_1), ..., P_{x,j,k}(t_{m_x})]$ the probability that mobile terminal x, currently in cell j, to be active in cell k, and therefore under the control of base station k, at times t_0, t_1, t_2, ..., t_{m_x}. $P_{x,j,k}(t)$ represents the projected probabilities that a mobile terminal will remain active in the future and at a particular location. It is referred to as the Dynamic Mobile Probability (DMP) in the following. The parameter m_x represents how far in the future the predicted probabilities are computed. It is not fixed for all users and can depend of the user QoS (e.g. higher QoS users will have a higher value of m) or the actual connection elapsed time (e.g. new connection will have a high value of m).

Those probabilities may be function of several parameters such as:

- residence time of mobile x in cell j,
- handoff probability,
- the distribution of call length for a mobile terminal x when using a given service class,
- cell size,
- user mobility profile.

Of course, the more information we have, the more accurate are the probabilities, and hence the more complex is their computation.

For each user x in the network, the cell that is responsible for, decides the size of the cluster $K(x)$, those are the cells involved in the CAC process, and sends the DMPs to all members in $K(x)$. The cell must specify if the user is a new one (in which case the cell is waiting for responses from the members of $K(x)$) or not.

DMPs could range from simple probabilities to complex ones. Simple probabilities can be obtained by assuming, for example, that call length is exponentially distributed, that the call arrival process follows a Poisson distribution, that the handoff probabilities are equal in any direction and so on (Manhattan cellular network, small cluster).

DMPs can also be complex for example by including information about user mobility profiles. A method for computing dynamic mobile probabilities taking into consideration mobile terminal direction, velocity and statistical mobility data, is presented in [6]. Other schemes to compute these probabilities are presented in [1, 7]. To compute these probabilities, one can also use mobiles' path/direction information readily available from certain applications, such as the route guidance system of the Intelligent Transportation Systems with the Global Positioning System (GPS).

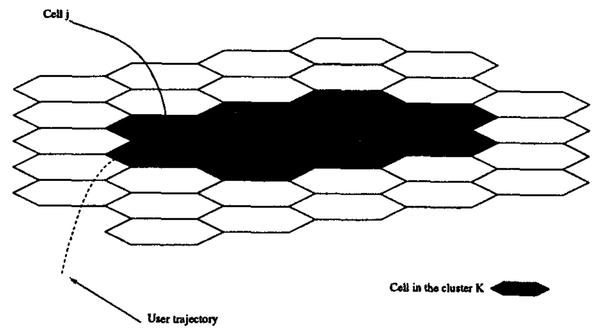

Figure 1: Cell j and the cluster for a user

4. LOCAL CALL ADMISSION CONTROL

User's traffic can be either voice, data or video. Voice users are usually characterized by a fixed bandwidth demand. Data and video users have a dynamic bandwidth requirement due to the burstiness of the carried traffic. Without loss of generality, we assume that all users are characterized by a bandwidth demand distribution $f_x(E_x(c), \sigma_c)$. Where $E_x(c)$ and σ_c are the mean and the standard deviation of the distribution f_x respectively, and c is user's x type of traffic. $E_x(c)$ depends of user x traffic type c (audio, data or video).

We assume also that each class of traffic c can be handled with various values of $E_x(c)$. We assume that $E_x(c)$ takes values between $B_{low}(c)$ and $B_{high}(c)$ for each class of service c. Accordingly, the QoS demand corresponding to the distribution $f_x(B_{low}(c), \sigma_c)$ is noted $QoS_{low}(c)$ while the QoS demand corresponding to the distribution $f_x(B_{high}(c), \sigma_c)$ is noted $QoS_{high}(c)$.

In conjunction with the emergence of adaptive multimedia encoding [9, 8, 3], QoS adaptation schemes have been proposed to reduce handoff drops. In these schemes a connection's QoS can be downgraded if the available bandwidth in the new cell is not sufficient [4, 7]. Such schemes can be easily integrated in our framework as part of the local call admission control.

4.1 Computing Elementary Responses

At each time t_0 each cell, in a cluster $K(x)$ involved in our CAC process for user x, makes a local CAC decision for different times in the future $(t_0, t_1, ..., t_{m_x})$. Based on these CAC decisions, we call Elementary Responses, the cell makes a final decision which represents its local response to the admission of user x in the network. Elementary responses are time dependent. The computation of these responses is different according to the user location and type. The user can be either a local new user or a new user that has a non null probability to be in this cell in the near future.

4.1.1 *User types*

A cell may be involved in the processing of different types of user. Possible user types at time t_0 are:

1. Old users local to the cell
2. Old users coming from another cell (executing a hand-off)
3. New users (at time t_0) from within the cell
4. New users (at time t_0) from other cells

New users are defined as all users seeking admission at time t_0. Users of type 1 have the highest priority. Priority between other users is subject to some ordering policy. The network try to support old users if possible and uses the DMPs to check if a cell can accommodate a new user who will possibly come to the cell in the future.

If QoS adaptation is used, the cell can accommodate a call if it can support this call with at least the user's minimum QoS $(QoS_{low}(c))$.

4.1.2 *Local CAC at time t_0 for time t_0*

The cell can apply any local call admission algorithm to compute the elementary responses. In this work we assume that the cells use the Equivalent Bandwidth approach to compute these responses. Example of such a scheme is described in [2].

In order to better serve multimedia users, the cell will reserve a fixed small amount of bandwidth for the multimedia user for the lifetime of her/his connection. This fixed amount of reserved bandwidth will guarantee a minimum QoS as proposed previously in the literature.

The processing of local new users will be explained in section 5.

4.1.3 *Local CAC at time t_0 for time t_l $(t_l > t_0)$*

Each base station (BS) computes the equivalent bandwidth at different times in the future according to the DMPs of future users.

If user x, in cell j at time t_0, has a probability $P_{x,j,k}(t_l)$ to be active in cell k at time t_l and has a bandwidth demand distribution function $f_x(E_x(c), \sigma_c)$, then cell k should consider a user x', for time t_l, with a bandwidth demand distribution function $f'_{x'}(E_x(c) \times P_{x,j,k}(t_l), \sigma_c)$ and use it to perform its local call admission control.

We denote $r_k(x, t)$ the elementary response of cell k for user x for time t.

The cell sets in which order of users it will perform its call admission control. For instance, the cell can sort users in a decreasing order of their DMPs.

If we assume that user x_i has higher priority than user x_j for all $i < j$, then to compute elementary responses for user x_j, we assume that all users x_i with $i < j$ that have a positive elementary response are accepted. As an example, if a cell wants to compute the elementary response r for user x_4, and we have already computed r for users $x_1 = 1$, $x_2 = 1$ and $x_3 = 0$, then to compute r for x_4 the cell assumes that user 1 and 2 are accepted in the system but not user x_3.

We propose also that the cell reserves some bandwidth in case of an erroneous prediction. This amount of reserved bandwidth is a parameter of our scheme and can be tuned to have the best performance. The choice of this parameter depends on the precision of the DMPs.

4.2 Computing the Final Responses and Sending the Results

Since the elementary responses for future foreign users are computed according to local information about the future, they should not be assigned the same confidence degree. Indeed, responses corresponding to the near future are more likely to be more accurate than those of the far future.

We denote $C_k(x, t)$ the confidence that has cell k about its elementary response $r_k(x, t)$. The question arises on how the cell can compute (or simply choose) the confidence degrees $C_k(x, t)$, typically between 0% and 100%. One way to compute the confidence degrees is to use the percentage of available bandwidth when computing the elementary response as an indication of the confidence the cell may have in this elementary response.

If for user x, cell k has a response $r_k(x, t)$ for each t from t_0 to t_m with a corresponding DMPs $P_{x,j,k}(t_0)$ to $P_{x,j,k}(t_m)$, then to compute the final response those elementary responses are weighted with the corresponding DMPs. The final response from cell k to cell j concerning user x is then :

$$R_k(x) = \frac{\sum_{t=t_0}^{t=t_{m_x}} r_k(x,t) \times P_{x,j,k}(t) \times C_k(x,t)}{\sum_{t=t_0}^{t=t_{m_x}} P_{x,j,k}(t)} \qquad (1)$$

where $C_k(x, t)$ is the confidence that has cell k about the elementary response $r_k(x, t)$. To normalize the final response each elementary response is also divided by the sum over time t of the DMPs in cell k. Of course, the sum $\sum_{t=t_0}^{t=t_{m_x}} P_{x,j,k}(t)$ should not be null (which otherwise means that all the DMPs for cell k are null!). Cell k, then, sends the response $R_k(x)$ to the corresponding cell j.

5. DISTRIBUTED CAC

Here the decision takes into consideration the responses from all the cells in the user cluster. The admission process concerns only new users seeking admission to the network and not already accepted users.

We assume that cell j has already decided the cluster $K(x)$ and that cell j has already assigned to each cell k in the cluster $K(x)$ a weight $W_k(x)$. Each weight represents the importance of the contribution of the associated cell to the global decision process. Usually a cell that is involved more in supporting the user has a high weight value. Weights $W_k(x)$ depend on the DMPs and the time t.

We suggest to use the following formula to compute the weights $W_k(x)$:

$$W_k(x) = \frac{\sum_{t=t_0}^{t=t_{m_x}} P_{x,j,k}(t)}{\sum_{k' \in K} \sum_{t=t_0}^{t=t_{m_x}} P_{x,j,k'}(t)} \quad (2)$$

If we assume that each response $R_k(x)$, from cell k, is a percentage between 0% (can not be supported at all) and 100% (can be supported), then the cell computes the sum of $R_k(x) \times W_k(x)$ over k. Note that the response $R_k(x)$ from cell k is not time dependent as cell k includes time consideration when computing $R_k(x)$ (see section 4.2, eq. 1).

The final decision of the call admission process for user x is based on

$$D(x) = \sum_{k \in K} R_k(x) \times W_k(x) \quad (3)$$

If $D(x)$ is higher than a certain threshold then, user x is accepted; otherwise the user is rejected. The threshold can be specified by the user. The more higher is the threshold the more likely the user connection will survive in the event of a handoff.

Combining eq. 1 and eq. 2, eq. 3 can be written as:

$$D(x) = \frac{1}{\alpha} \sum_{k \in K} \sum_{t=t_0}^{t=t_{m_x}} r_k(x,t) \times P_{x,j,k}(t) \times C_k(x,t) \quad (4)$$

with $\alpha = \sum_{k' \in K} \sum_{t=t_0}^{t=t_{m_x}} P_{x,j,k'}(t)$.

Only the value $\sum_{t=t_0}^{t=t_{m_x}} r_k(x,t) \times P_{x,j,k}(t) \times C_k(x,t)$ should be computed locally in each cell, and the final result is then, simply the sum of all responses from all the cells in the cluster K divided by α.

6. THE ALGORITHM

Each time t, a cell j should decide if it can support new users. It decides locally if it can support users of type 1 and 2 that have higher priority than other types of user (cf. user types in section 4.1.1). This is because, from a user point of view, receiving a busy signal is more bearable than having a forced termination. The cell also sends the DMPs to other cells and informs them about its users of type 3. Only those who can be supported locally are included, other users of type 3 that can not be accommodated locally are rejected. At the same time, the cell receives DMPs from other cells and is informed about users of type 4.

Using equation 1, the cell decides if it can support users of type 4 (possibly with some QoS adaptation) in the future and it sends the responses to the corresponding cells. When it receives responses from the other cells concerning its users of type 3, it performs one of the two following steps: If the cell can not accommodate the call, the call is rejected. If the cell can accommodate the call, then the CAC decision depends on the response of the other cells and the probabilities that the users will be in those cells in the future. In the following, we will describe the details of the local call admission control scheme.

At time t_0, cell j has n_1 old clients local to cell j, n_2 old clients coming from another cell (k), n_3 new clients originating in cell j and n_4 new clients originating from another cell (k).

Cell j has to decide how to distribute available bandwidth among those clients. Old clients local to cell j will (all if possible) be supported at time t_0, and cell j should decide which of the other users will be allowed to use the remaining bandwidth.

Old users coming from other cells are processed first (after old local clients). The cell will use some priority policy to sort the clients. For example, it could sort them according to their connection elapsed time, user profile or QoS.

Then the cell starts with the client that has the highest rank and executes a local call admission control. The cell decides the size of the old user cluster and the parameter m and sends the dynamic mobile probabilities to all the cells in the corresponding cluster. If there is some bandwidth left, cell j proceeds as follows:

For each of its new clients x, cell j chooses a cluster $K(x)$ of cells that will be involved in the admission process of the considered client x and chooses a depth m_x to be used as how much steps in the future the dynamic mobile probabilities will be computed. Those cells in the cluster $K(x)$ depend on the client direction and speed, and possibly the land topology. Cell j sends to all those cells the dynamic mobile probabilities of the user and waits for their responses.

Cell j will possibly receive dynamic mobile probabilities for new users originating at other cells, along with dynamic mobile probabilities for old users in close vicinity of the cell.

Cell j will sort all old users according to their respective dynamic mobile probabilities and all new users (either local or not) according to some ordering policy, and proceeds as follows:
for each time t from t_0 to the maximum over x of t_{m_x}

1. if $t = t_0$ begin with the user x that has the highest rank (old users have always higher priorities than new ones).
   If $t \neq t_0$, begin with the user x (with $t < t_{m_x}$) that has the highest dynamic mobile probability and was accepted in the previous step.

2. consider a user x' that has the following bandwidth requirement $f'_{x'}(E_x(c) \times P_{x,j,k}(t), \sigma_c)$ where $f_x(E_x(c), \sigma_c)$ is the bandwidth requirement of user x, and process user x' using the local call admission control algorithm.

If user x is of type 3 or 4 then, if user x' is accepted then set $r_j(x,t)$ to 1, else set $r_j(x,t)$ to 0. Cell j also decides what is its confidence $C_j(x,t)$ in the elementary response $r_j(x,t)$.

3. If this is not the last user, go to step 1 and proceed with the next user.

For all new users x_{type_4} of type 4, cell k computes the final responses $R_k(x_{type_4})$ according to eq. 1 and sends the results to the corresponding cell (the cell responsible for users x_{type_4}).

When receiving responses from all the cells in the cluster $K(x)$ for user x of type 3, cell j computes the final decision $D(x)$ using eq. 3. If $D(x)$ is higher than the threshold specified by user x, the user is accepted, the user is rejected otherwise.

7. PERFORMANCE EVALUATION

7.1 Simulation parameters

For the sake of simplicity, we evaluate the performance of our Distributed Call Admission Control for mobile terminals which are traveling along a highway. This is the simplest environment representing a one-dimensional cellular system. In our simulation study we made the following assumptions:

1. The time is quantized in intervals $T = 10s$
2. The whole cellular system is composed of 10 linearly-arranged cells, laid at 1-km intervals.
3. During each time interval, connection requests are generated in each cell according to Poisson process. A newly generated mobile terminal can appear anywhere in the cell with equal probability.
4. Mobile terminals can have speeds of: 70, 90, or 105 km/h. The probability of each speed is 1/3, and mobile terminals can travel in either of two directions with equal probability.
5. We consider three possible types of traffic: voice, audio, or video. The probabilities of these types are 0.7, 0.2, 0.1 respectively. The number of bandwidth units (BUs) required by each connection type is: voice = 1, audio = 5, video = 10. Note that fixed bandwidth amounts are allocated to users for the sake of simplicity.
6. Connection lifetimes are exponentially-distributed with mean value equal to 180 seconds.
7. Each cell has a fixed capacity of 40 bandwidth units.
8. m_x is fixed for all users and for the duration of the connection and is equal to 18. This means that the DMPs are computed for 18 steps in the future.
9. The size of the cluster $K(x)$ is fixed for all users and is equal to 5. This means that four cells in the direction of the user along with the cell where the user resides form the cluster.
10. We simulate a total of 4 hours of real-time highway traffic, with a constant cell load equal to 360 new calls/h/cell.
11. The DMPs are computed as in [6].
12. All users have the same threshold.
13. The confidence degree is computed as follows: $Confidence = e^{(1-p)} * p^3$ where p is a real between 0 and 1 representing the percentage of available bandwidth at the time of computing the elementary response.

7.2 Simulation results

In our simulations, a user x requesting a new connection is accepted into a cell only if the final decision $D(x)$ is above a rejection threshold value. We varied this threshold value to observe its effect on the call dropping percentage and the average bandwidth utilization in the cells of the network.

By varying the value of the threshold in the simulations, we were able to decrease the percentage of dropped calls while maintaining a good average bandwidth utilization.

Figure 2 depicts the average bandwidth utilization of the cells in the network, and the corresponding percentage of dropped calls for different threshold values.

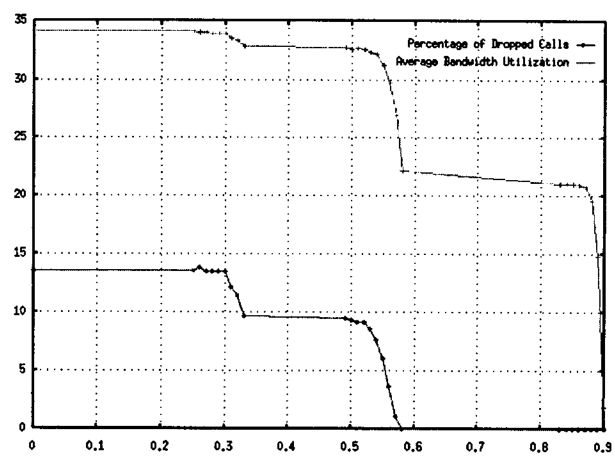

Figure 2: Average bandwidth utilization and percentage of dropped calls, Distributed CAC case

The top curve represents the average number of BU's that are used in all cells in the network, considering the entire simulation time. When the threshold is equal to zero, the average bandwidth utilization is at its maximum value. In this case, the maximum bandwidth utilization is approximately equal to 34 BU's. The bottom curve depicts the percentage of dropped calls in the network. The highest percentage of dropped calls also occurs when the threshold is equal to zero; in this case, all connection requests are accepted regardless of the final decision $D(x)$, as long as there is available bandwidth in the cells where the connections are requested. For the simulated cell load, the maximum percentage of dropped calls is equal to 14%. By adjusting the threshold value, our distributed call admission control scheme can control the percentage of calls that will be dropped. For example, with a threshold value of 57%, the percentage of dropped calls is reduced to the value of 1% while maintaining at the same time a high average bandwidth utilization value of 27 BUs. The proposed scheme allow a tradeoff between average bandwidth utilization and the percentage of dropped calls. If the threshold value is 83% then no calls need to be dropped with a corresponding average bandwidth utilization of 21 BUs. Thus, the proposed scheme can reduce the percentage of dropped calls with an acceptable degradation in total bandwidth utilization.

In order to compare the performance of our scheme to an alternative one, we simulate the same network but with the admission of new connections done in a random fashion. In this experiment, new connections are admitted in the network when a random number in the interval (0,1) generated for each new connection is above a threshold value (provided there was enough bandwidth in the cell to support the new connection). In other words, for a threshold value equal to l, the base station tried to accept $100 \times (1-l)\%$ of all new connection requests to the network.

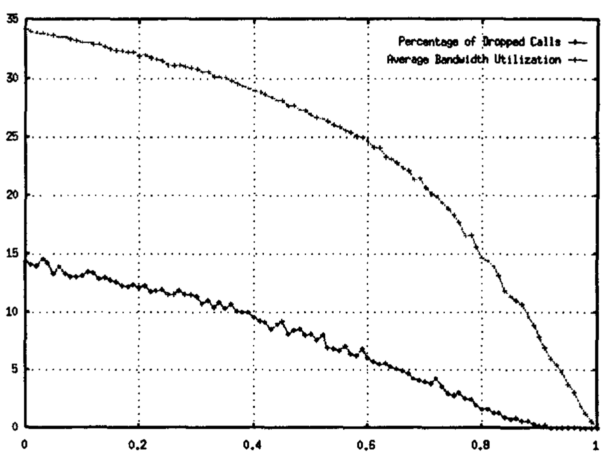

Figure 3: Average bandwidth utilization and percentage of dropped calls, random admission case

Figure 3, depicts the average bandwidth utilization and the percentage of dropped calls for a network that is using random admission. To have a percentage of dropped calls value equal to 1% the threshold value should be greater than 92%, with a corresponding average bandwidth utilization of only 6 BUs. In comparison, for the same percentage of dropped calls 1%, our scheme allows a very high average bandwidth utilization of about 27 BUs.

In figure 4, we compare the percentage of refused calls, as a function of the threshold value, when using our scheme and when using random admission. Note that a rejection percentage equal to 0% is not possible, even when the threshold is equal to zero. This is because it is not possible to accept a new connection request if there is not enough bandwidth available for the call. In this case, the minimum rejection percentage is approximately 21%. From figure 4, to obtain a negligible call dropping rate the random admission scheme needs to reject almost all new connection requests,

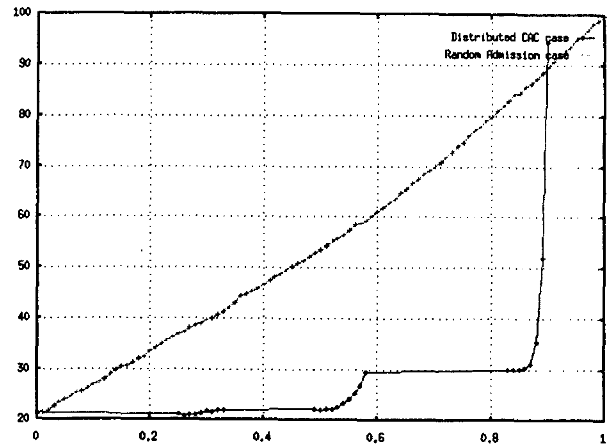

Figure 4: Percentage of refused calls

while with our algorithm, similar call dropping rates can be achieved while refusing less than 30% of all call admission requests. For example, to have a percentage of dropped calls of 1%, the random admission scheme refuses 92% of all new connection requests, while our scheme rejects only 30% of all new admission requests.

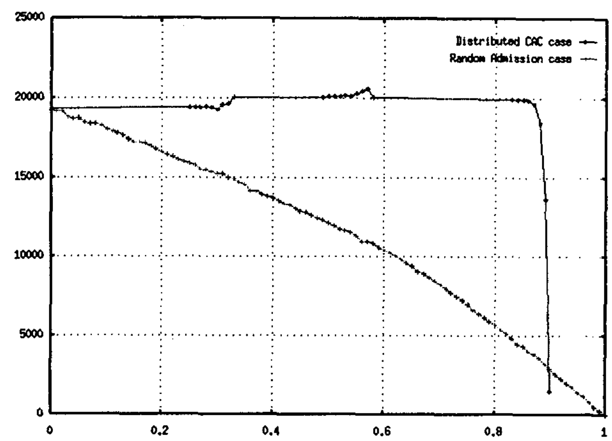

Figure 5: Number of finished calls

In figure 5, we compare the number of finished calls when using our scheme and when using random admission. Finished calls refer to all users that were admitted to the network and that finished their calls without any problem. As expected from the random admission, we can observe that the number of finished calls decreases monotonically as the threshold value increases. This can be explained by the fact that random admission rejects more and more new requests as the threshold value decreases. However, the number of finished calls when using our scheme experiences a slight growth while the threshold value increases. This is due to the reduction of the call dropping rate which allows more users to finish their calls while still admitting new requests. When the threshold value is very high, both schemes experience a smaller number of finished calls. Note that for a percentage of dropped calls equal to 1%, the random admission scheme allow only about 2000 users to finish their calls, while our scheme allows almost 20000 users to finish their calls without any problem.

8. CONCLUSION

In this paper, we have described a novel call admission control algorithm suitable for wireless multimedia networks. The proposed algorithm operates in a distributed fashion by involving, in a call admission decision, not only the cell where the call originated, but also a determined number of neighboring cells. The goals underlying the design of our algorithm are: (1) to support mobile multimedia users with dynamic bandwidth requirements; (2) to reduce the call dropping probability while maintaining a high network resource utilization; and (3) to distribute call admission control among clusters of neighboring cells to allow more clear-sighted decisions and hence a better user survivability in the network. Previous works have addressed these issues separately which makes this work, in pursuing these goals simultaneously, of a pioneering nature. More technically, our algorithm can integrate easily any method for computing Dynamic Mobile Probabilities (DMPs). It can also rely on different local call admission control schemes including those designed for adaptive multimedia applications.

Simulations results have shown a significant improvement in the considered system. By implementing the proposed algorithm, the system is able to lower the call dropping probability while offering a high average bandwidth utilization. The system is also able to maintain a high acceptance probability for new users. The signaling load induced by the algorithm operation is considered here acceptable as far as it only involves few messages exchanged between base stations through the wired network which is assumed to be of high capacity. More simulations are envisaged in the future to evaluate our algorithm in more sophisticated situations, for example with users having dynamic bandwidth requirements, cell loads, and traffic distributions. Also envisaged is studying the influence of the number of cells involved in a call admission decision.

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