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Improving QoS in 3G Wireless Mobile N/W Using Call Admission Control Scheme

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Abstract—Call admission control schemes play more important role in wireless cellular networks. They are used for achieving some desired quality of service parameters. The design of call admission control algorithms for mobile cellular networks is especially challenging given the limited and highly variable resources, and the mobility of users encountered in such networks. This paper discusses different schemes for providing Quality of Service (QoS) in cellular networks.

This paper provides a survey of admission control schemes & Handoff Prioritization for cellular networks and the research in this area. Our goal is to provide a broad classification and thorough discussion of existing call admission control schemes. We describe several admission control schemes. Handoff is an essential element of cellular communications. Handoff prioritization is the common characteristic of these schemes.

Key words- Call admission control schemes Quality of Service, Handoff

I. INTRODUCTION

Third generation radio communication systems are designed to offer multimedia services, including voice and video telephony and high-speed Internet accessIn 2G networks such as Global System for Mobile communications (GSM)/code-division multiple access (CDMA), there was essentially only one quality of service (QoS) – e.g. speech at full-rate coding in GSM. Then, half-rate service was introduced, thus offering a new QoS. In reality, however, this was done to save network capacity and therefore serving more users in congested hot spots, rather than offering a new grade of service (together with tariff changes).[2]

The 3G technology is a developing technology for the future mobile communication. Nevertheless, along with the development of the 3G mobile technologies, the development of the consumer electronics will also grow. The 3G services add a valuable mobile dimension to services that have already become an integral part of modem life, such as the internet and intranet access, and video-conferencing. With the support of higher data transmission rate for mobile users, 3G networks are expected to support different broadband multimedia services, and hence, leading to the increasing provision of the products for consumer electronics, like video mobile phones and 3G broadband PCMCIA cards. Apart from the appearance of the products, a key factor that most end users concern is the diverse quality-of-service (QoS) requirement of the system. In other words, the network performance will affect the market of the products in consumer electronics, indirectly.[4]

II. SYSTEM DESIGN

A. *Call admission control*

There are many QoS schemes which have been deployed for cellular networks and each scheme has its own advantages and disadvantages. Fault Tolerant Dynamic Allocation scheme ,the channels are allocated dynamically based on demand and hence increasing the channel utilization and also the QoS. The channel allocation schemes are centralized and distributed. In a centralized approach there is a central controller which is responsible for channel allocation and requests are sent to the controller, whereas in a distributed approach there exists a Mobile Service Station (MSS) in each cell which takes care of the channel allocation for that particular cell. Distributed approach is more scalable and reliable and thus this approach is used in this algorithm.[1]

The next scheme is the Call Admission Control (CAC). In the CAC algorithm new call arrival rates are estimated continuously and if they are higher than a predetermined level some calls are blocked irrespective of whether a channel is available or not. The objective of this scheme is to maintain the new call arrival rate lesser than a predetermined level. In this scheme a comparison is made with the existing two schemes namely prerequest scheme and the guard channel scheme and various advantages and disadvantages are given for the two schemes and then a CAC algorithm is developed which provides a better QoS than the existing two schemes. The two metrics used for QoS in this algorithm are Forced Termination Probability (FTP) which is defined as the ratio of the number of calls which are forced to terminate because of failed handoff to the number of calls that successfully entered the network. Another metric is the Successful Call Completion Rate (SCCR) which is defined as the number of calls which are completed successfully in a unit time by each cell.[1]

Call admission control (CAC) is a technique to provide quality-of-service (QoS) in a network by restricting the access to network resources. Simply stated, an admission control mechanism accepts a new call request provided there are adequate free resources to meet the quality-of-service (QoS) requirements of the new call request without violating the committed quality-of-service (QoS) of already accepted calls. There is a tradeoff between the quality-of-service (QoS) level perceived by the user (in terms of the call dropping probability) and the utilization of scarce wireless resources. In fact, call admission control (CAC) can be described as an optimization problem.[1] In the Guard Channel Scheme some channels are exclusively reserved for the handoff calls and these channels are called guard channels.[1] Mobile prediction techniques are employed to find the path or the trajectory of a mobile node and it is stored in a database from time to time.[1]

In a Dynamic Allocation scheme using Renegotiation, the unused resources of the network are explored and they are allocated to services which got a lesser and width at the time of admission when they actually wanted more. In other words, renegotiation of the bandwidth is done for a lower priority service when the medium is free, thus increasing the overall bandwidth of the lower priority services. The scheme on the other hand also maintains the bandwidth of the higher priority sources.[1]

In general there are two categories of call admission control (CAC) schemes in cellular networks:

1. Deterministic Call Admission Control (CAC**):** Quality-of-service (QoS) parameters are guaranteed with 100% confidence. Typically, these schemes require extensive knowledge of the system parameters such as user mobility which is not practical, or sacrifice the scarce radio resources to satisfy the deterministic quality-of-service (QoS) bounds.
2. Stochastic Call Admission Control (CAC): Quality-of-service (QoS) parameters are guaranteed with some probabilistic confidence. By relaxing quality-of-service (QoS) guarantees, these schemes can achieve a higher utilization than deterministic approaches. [1]

Call admission control (CAC) schemes can be classified based upon the number of services/classes. Single-class call admission control (CAC) has been dominant in first and second generation (2G) wireless cellular networks when voice service was the main (and sometime the only) offered service. With the growing interest of data and multimedia services, single-class call admission control (CAC) schemes are no longer sufficient and as a result multiple-service/class call admission control (CAC) schemes are more relevant, especially in the enhanced second generation (2.5G) and third generations and beyond (3G/4G). The design of multiple-service/class call admission control (CAC) schemes is more challenging since some critical issues, such as service prioritization, fairness, and resource sharing policy, must be considered.

Optimal call admission control (CAC) schemes are always preferred, but they are not necessarily attainable, particularly in realistic scenarios with a large problem size and complicated system parameter interdependence. As such, heuristics and intelligent techniques are widely used to find suboptimal call admission control (CAC) scheme.Call admission control (CAC) schemes can be classified as proactive (parameter based) or reactive (measurement-based). In proactive call admission control (CAC) schemes, the incoming call is admitted/denied based on some predictive/analytical assessment of the quality-of-service (QoS) constraints. In reactive call admission control (CAC) schemes, the incoming call might start transmission (by transmitting some probing packets or using reduced power). Then the reactive call admission control (CAC) scheme decides to admit/reject the call based on the QoS measurements during the transmission attempt at the beginning.

Call admission control (CAC) can also be classified based on the information needed in the call admission control (CAC) process. Some CAC schemes use the cell occupancy information. This class of call admission control (CAC) schemes requires a model or some assumption for the cell occupancy. Alternatively, call admission control (CAC) schemes might use mobility information (or estimation) in making the admission decision. The use of mobility information, however, is more complicated and requires more signaling.

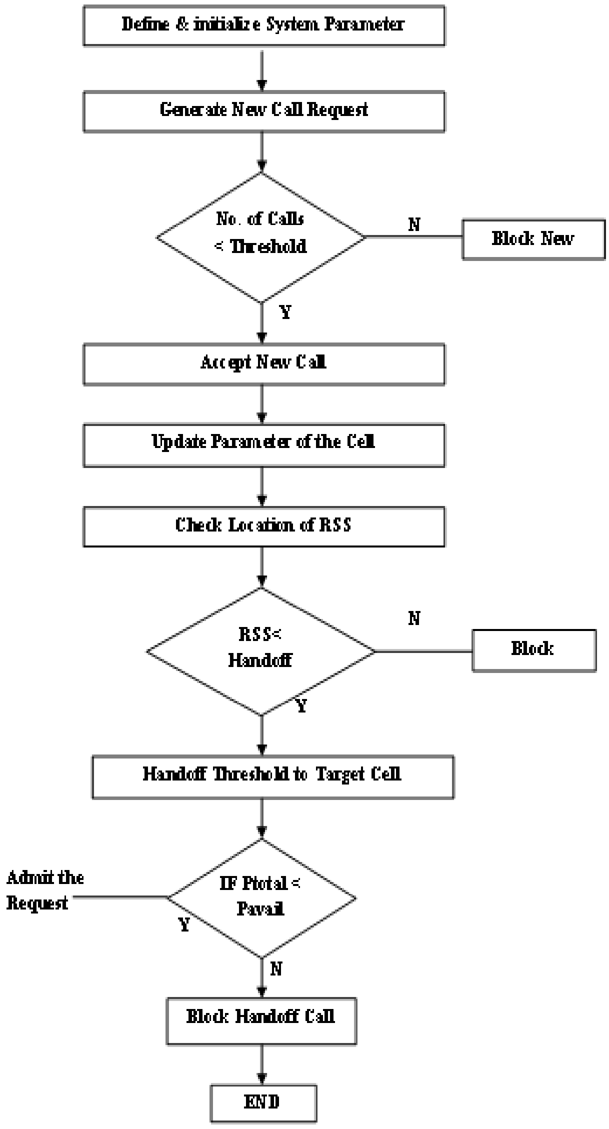

Figure 1: Flow Chart for CAC Handoff Prioritization Algorithm

The Intelligent System to measure system parameters is developed in Matlab. The system will detect which type of multimedia request is demand. The multimedia request can be audio, data, images or text. The system will then apply its parameters on the multimedia request. The system parameters are firstly throughput which is nothing but the measurement of the rate of data transfer through a network. Secondly signal to noise ratio is the ratio which computes the minimum required power for the new user and accepts it if is not below a predefined minimum link quality level. Thirdly bit error rate which is the frequency of errors that occur when bits are transmitted in a digital system.

Fourthly response time which is the time taken by a system or to react a given input. Then the new call request is generated and the request is send to the base station. The bandwidth of 3G is 3 GHz. The channels are available for traffic management is three. The bandwidth divided between these three channels is as for audio it is 2 GHz, for text it is 0.5 GHz and for image it is 0.5 GHz. The allocation of resources to users will depend on the cell size.Now it will accept the new call, will check with the requirement of the call with recently available resources. It will check the location of Remote switching system. In the Remote switching system if the Request < Threshold, it will go to the first step the resources & update the parameter in the available section and it will follow the same steps and if the condition is not satisfied then request will be denied. For request received it will check if it is a handoff call/request is received and also will check with the required resources by the hand off call is Request power < available resources power. If yes it will grant them and update the status of available resources with it else it will discard the resource.

B. Quality of Service

Quality of Service (QoS) in cellular networks is defined as the capability of the cellular service providers to provide a satisfactory service which includes voice quality, signal strength, low call blocking and dropping probability, high data rates for multimedia and data applications etc. For network based services QoS depends on the following factors.

Throughput -The rate at which the packets go through the network. Maximum rate is always preferred.

Delay- This is the time which a packet takes to travel from one end to the other. Minimum delay is always preferred.

Packet Loss Rate- The rate at which a packet is lost. This should also be as minimum as possible.

Packet Error Rate -This is the errors which are present in a packet due to corrupted bits. This should be as minimum as possible

In 2G networks such as Global System for Mobile communications (GSM)/code-division multiple access (CDMA), there was essentially only one quality of service (QoS) – e.g. speech at full-rate coding in GSM. Then, half-rate service was introduced, thus offering a new QoS.[1]

Imagine a situation where you are hardly able to hear what your friend is talking over the phone or the phone gets cut when you are talking something important. These things are highly undesirable and you do not want to get low quality service for paying high monthly bills. Communication plays a major role in today's world and to support it QoS has to be given maximum priority. It is important to differentiate the traffic based on priority level. Some traffic classes should be given higher priority over other classes, Example: voice should be given a higher priority compared to data traffic as voice is still considered as the most important service. It should be noted that more preference has to be given to customers who pay more to get better service, without affecting the remaining customers who pay normal amount. To realize all these things effective QoS schemes are needed. Issues and schemes related to providing better QoS is the main subject of this report. [1]

In wireless mobile networks QoS refers to the measurement of a system with good transmission quality, service availability and minimum delay. In 4G it is expected to have a reliability of at least 99.999 referred to as five nine reliability. The major challenges when considering QoS in cellular networks are varying rate channel characteristics, bandwidth allocation, fault tolerance levels and handoff support among heterogeneous wireless networks. It is fortunate that each layer which includes physical, MAC, IP, TCP and application have got their own mechanisms to provide QoS. It is important to guarantee QoS in each layer so that the network is more flexible and tolerant to QoS issues. Some of the other challenges are efficient usage of the spectrum as its availability is limited. Bandwidth allocation plays a major role with respect to this aspect. It must be made sure that bandwidth is allocated in an efficient manner and also the remaining bandwidth should not be wasted. Some schemes like Renegotiation scheme takes care of this issue by allocating the remaining bandwidth to lower priority classes. Things get even more complicated when data and voice service has to be supported. Voice services are very delay sensitive and require real-time service. On the other hand data services are less delay sensitive but are very sensitive to loss of data and also they expect error free packets. So both these factors have to be considered for providing QoS for voice and data services. [1]

In 1G networks and 2G networks such as GSM and CDMA there was only one aspect of QoS and it is voice. Providing quality speech was the major concern. Now in 3G networks QoS has to be provided for voice as well as data. Still priority is given for voice services as they are considered as the primary service. They are very delay sensitive and require real-time service. Data services are comprised of text and multimedia. These services are less delay sensitive but expect better throughput and less or no loss rate.[1]

C *Handoff Prioritization*

One of the ways to reduce the handoff failure rate is to prioritize handoff. Handoff algorithms that try to minimize the number of handoffs give poor performance in heavy traffic situations. In such situations, a significant handoff performance improvement can be obtained by prioritizing handoff.[3]

Two basic methods of handoff prioritization, guard channels and queuing, are.

Guard Channels — Guard channels improve the probability of successful handoffs by reserving a fixed or dynamically adjustable number of channels exclusively for handoffs. For example, priority can be given to handoff by reserving N channels for handoffs among C channels in the cell . The remaining $(C – N)$ channels are shared by both new calls and handoff calls. A new call is blocked if the number of channels available is less than $(C – N)$. Handoff fails if no channel is available in the candidate cell. However, this concept has the risk of underutilizing spectrum. An adaptive number of guard channels can help reduce this problem. Efficient usage of guard channels requires the determination of an optimum number of guard channels, knowledge of the traffic pattern of the area, and estimation of the channel occupancy time distributions.[3]

Queuing of Handoff — Queuing is a way of delaying handoff ; the MSC queues the handoff requests instead of denying access if the candidate BS is busy. Queuing new calls results in increased handoff blocking probability. The probability of a successful handoff can be improved by queuing handoff requests at the cost of increased new call blocking probability and a decrease in the ratio of carried-to-admitted traffic since new calls are not assigned a channel until all the handoff requests in the queue are served. Queuing is possible due to the overlap region between the adjacent cells in which MS can communicate with more than one BS. If handoff requests occur uniformly, queuing is not needed; queuing is effective only when handoff requests arrive in groups and traffic is low for two reasons. First, if there is a lot of traffic, it is highly unlikely that a queued handoff request will be entertained. Second, when there is moderate traffic and traffic arrives in bundles, a queued handoff request is likely to be entertained due to potential availability of resources in the near future and the lower probability of new handoff requests in the same period. Queuing is very beneficial in macrocells since the MS can wait for handoff before signal quality drops to an unacceptable level. However, the effectiveness of queuing decreases for microcells due to stricter time requirements. The combination of queuing and channel reservation can be employed to obtain better performance. [3]

The handoff schemes can be classified according to the way the new channel is set up and the method with which the call is handed off from the old base station to the new one. At call-level,there are two classes of handoff schemes, namely hard handoff and soft handoff.[1]

1) Hard handoff: In hard handoff, the old radio link is broken before the new radio link is established and a mobile terminal communicates at most with one base station at a time. The mobile terminal changes the communication channel to the new base station with the possibility of a short interruption of the call in progress. If the old radio link is disconnected before the network completes the transfer, the call is forced to terminate. Thus, even if idle channels are available in the new cell, a handoff call may fail if the network response time for link transfer is too long. Second generation mobile communication systems based on GSM fall in this category.[1]

2) Soft handoff: In soft handoff, a mobile terminal may communicate with the network using multiple radio links through different base stations at the same time. The handoff process is initiated in the overlapping area between cells some short time before the actual handoff takes place. When the new channel is successfully assigned to the mobile terminal, the old channel is released. Thus, the handoff procedure is not sensitive to link transfer time. The second and third generation CDMA-based mobile communication systems fall in this category. [1]

Soft handoff decreases call dropping at the expense of additional overhead (two busy channels for a single call) and complexity (transmitting through two channels simultaneously). Two key issues in designing soft handoff schemes are the handoff initiation time and the size of the active set of base stations the mobile is communicating with simultaneously. This study focuses on cellular networks implementing hard handoff schemes. [1]

III.CONCLUSION

The admission control guarantees that QoS requirements in terms of bit error rates and delays can be met for all users. Call admission control is a very important measure in CDMA system to guarantee the quality of the communicating links. In this paper, we have presented the admission control algorithm for mobile network. In this paper, We studied how the network capacity can be improved by the admission control based on direct monitoring of the QoS performance. Quality of Service plays a major role in cellular networks. In this report we have seen the various schemes for maintaining the QoS in cellular networks and each scheme has its own advantages and disadvantages. The CAC algorithm combined the advantages of two schemes namely pre request and the guard channel scheme and it proved to be much better than both these schemes for providing a better QoS for profiled users.

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