

# **Increase Quality of Service using Call Admission Control Schemes in Wireless Cellular Networks**

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**ABSTRACT:** Call admission control (CAC) is a radio resource management technique aimed at providing fair quality of service (QoS) and grade of service (GoS) to mobile users in cellular networks. GoS refers the probability of blocking a new call request while QoS refers to the probability of loss of communication quality. This work presents an overview of the various techniques adopted for CAC bearing in mind core issues in cellular networks like coverage, capacity, throughput, diverse QoS requirements of mobile users, and blocking probability. We make effort, realizing these few issues, to comparatively analyze the performance of these schemes in order to highlight their suitability for a homogenous/heterogeneous traffic class, single/multi-cell environment in the uplink direction of a cellular CDMA network.

**KEYWORDS:** Radio Resource Management, Call Admission Control Schemes, Grade of Service, Quality of Service

## **I. INTRODUCTION**

Presently, beyond 3G cellular communications systems are evolving to 4G technology based on orthogonal frequency-division multiple access (OFDMA) and multiple-input multiple-output (MIMO), with the goal of achieving data rates beyond 100Mbps. Optimal approaches to radio resources management (RRM) can significantly lower the cost of delivering data and multimedia services for the operators as well as improving the quality of services provided to users [1],[2]. The various techniques that are used in managing radio resources have been categorized in [1] into three sets. The first set includes frequency/time resource allocation schemes such as channel allocation, scheduling, transmission rate control, and bandwidth reservation schemes. The second set consists of power allocation and control schemes, which control the transmitter power of the mobile station (MS) and the base station (BS). The third set comprises call admission control, base station assignment, and handoff algorithms, which control the access port connection. Call Admission Control (CAC) is a technique used to grant or deny arriving calls access to the wireless network based on predefined criteria and possibly, taking the network load conditions into consideration. Traffic of admitted calls is then controlled by other RRM techniques such as scheduling, handoff, power and rate control schemes. Figure 1 shows the possibility of an integration of different technologies for seamless connectivity in 4G network. Due to heterogeneity of 4G networks, wireless devices have to process signals sent from different systems, discover available services, and connect to appropriate service providers [3]. A mobile cellular communication system can be divided into two segments: a radio access network that performs air-interface related functions and a core network that performs switching functions and interfaces to external networks, such as Internets or Public Switched Telephone Network (PSTN) [4]. The evolution of next generation technology (4G) is taking place at both the radio access network and the core network. The new air-interface standards include Wideband Code Division Multiple Access (WCDMA) and

cdma2000-1X. The corresponding wireless networks are Universal Mobile Telecommunications Systems (UMTS) and cdma2000. A mobile access network's key function is to carry a baseband signal processing for effective communication over the air.

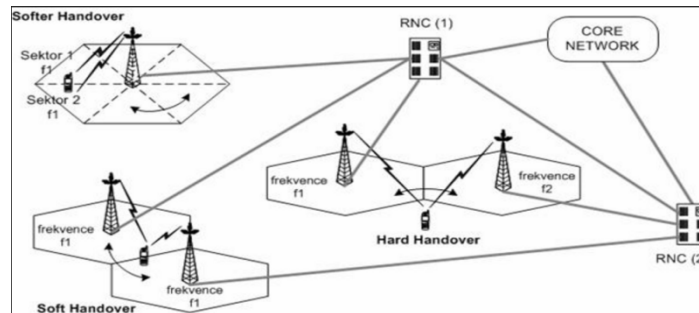


Figure 1: Accessing Multiple Networks and Services in 4G Technology

## II. LITERATURE REVIEW

The call admission control strategies investigated in the literature are variedly classified into types. Generally, Deterministic Call Admission Control and Stochastic Call Admission Control are the two categories of call admission control schemes in cellular networks [5]. In deterministic CAC, QoS parameters are guaranteed with 100% confidence. These schemes typically 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 QoS bounds. On the other hand, in stochastic CAC, QoS parameters are guaranteed with some probabilistic confidence. By relaxing QoS guarantees, these schemes can achieve a higher utilization than deterministic approaches. CAC schemes can also be classified as proactive (parameter-based) or reactive (measurement-based). In proactive schemes [6], the incoming call is admitted or rejected based on some predictive/analytical assessment of the QoS constraints. In reactive schemes [7], the incoming call might start transmission (by transmitting some probing packets or using reduced power) before the admission controller decides to admit or reject the call based on the QoS measurements during the transmission attempt at the beginning. In [8], CAC is classified based on the information needed in the CAC process. Some CAC schemes use the cell occupancy information [9]. This class of schemes requires a model or some assumption for the cell occupancy. Alternatively, 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. The information granularity used in CAC schemes can be considered at the cell level or at the user level. If a uniform traffic model is assumed, information of one cell is enough to represent the whole network condition. In a non-uniform traffic model, however, information from different cells is required to model the network status, which increases the information size. The third case, in which information of each individual user is considered, of course leads to a huge information size. Furthermore, CAC schemes have been designed either for the uplink [10] or the downlink [11]. In the uplink, transmit power constraint is more serious than in the downlink since the MS is battery operated. On the other hand, CAC in the downlink needs information feedback from MSs to the BSs for efficient resource utilization. Applying CAC for both links jointly is crucial since some calls might be admissible in one of the links and non-admissible in the other, particularly for asymmetrical traffic. In the uplink direction of a wireless network, one CAC is based on the number of users and is referred to as number-based CAC [3] and the other is based on the interference level and is referred to as interference-based CAC [12]. The operation of the number-based CAC schemes is quite similar to the fixed-assignment FDMA/TDMA systems. That means that capacity is 'hard' as the number of users that can be admitted into the system is fixed. The Signal to Noise Interference Ratio-based algorithm computes the minimum required power for the new user and accepts it if it is not below a predefined minimum link quality level.

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## III. SYSTEM MODEL

When a call request arrives, the mobile switching center uses the mobility information of all the mobiles in the cell and in the neighboring cells as well as their traffic characteristics to calculate the resource utilized by all the active calls. Then it estimates the resource requirement of the new call and finds the resource availability to accommodate the new call without degrading the QoS of accepted ongoing calls. So, the mobility information of the user, interference caused by the MSs at its home BS and from neighboring cells, the type of service request and load factor are the considered inputs into the system causing call blocking.

Hu Jian-ming; Li Jie; Li Guang-Hui describes an automobile anti-theft system using GSM and GPS module. The system is developed using high speed mixed type single-chip C8051F120 and stolen automobile is detected by the use of vibration sensor. The system remains in contact with automobile owner through the GSM module, for the safety and reliability of automobile [2]. Fleischer, P.B.; Nelson et al describes development and deployment of GPS (Global Positioning System)/GSM (Global System for Mobile Communications) based Vehicle Tracking and Alert System. This system allows inter-city transport companies to track their vehicles in real-time and provides security from armed robbery and accident occurrences [4]. Le-Tien, T.; Vu Phung describes a system based on the Global Positioning System (GPS) and Global System for Mobile Communication (GSM). It describes the practical model for routing and tracking with mobile vehicle in a large area outdoor environment .The system includes the Compass sensor-YAS529 of Yamaha Company and Accelerator sensor-KXSC72050 of Koinix Company to acquire moving direction of a vehicle. The system will acquire positions of the vehicle via GPS receiver and then sends the data to supervised center by the SMS (Short Message Services) or GPRS (General Package Radio Service) service. The supervised center comprises of a development kit that supports GSM techniques-WMP100 of the Wave com Company. Finally, the position of the mobile vehicle will be displayed on Google Map.

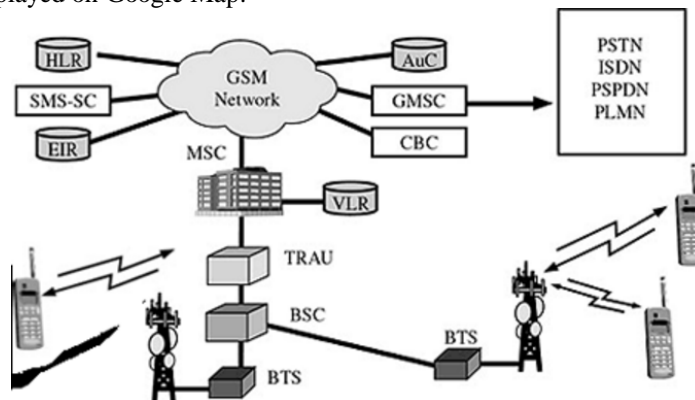


Figure 2: GSM Network Architecture

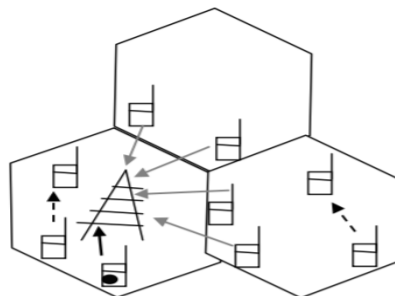


Figure 3: CDMA Near-far effect due to interference

## IV. PERFORMANCE EVALUATION

Figure 4 shows the system utilization  $U$ , evaluated as the average ratio between the used channels and the available ones (the average is evaluated on time and on the number of system cells). The trend is increasing for higher values of

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R and  $p_{min}$ : for higher coverage radius, the network reaches the saturation point, because the number of available channels decreases, while the call requests rate remains the same. In addition, with higher values of  $p_{min}$  there is the possibility to accept more MH requests.

New calls and handoff calls are treated equally. and in addition to that, the hand off calls are allowed to be queued and in addition to that hand off calls have higher load threshold and having channel holding time is 120 sec. Handoff calls are given higher priority to new calls, and load factor threshold for handoff calls and new calls are different.

Here only ten points consider for calculating grade of service

- 8.32096007091391, 9.61183085217341,
- 10.0646578114902, 10.2949159141129,
- 10.4342499886610, 10.5276187782227,
- 10.5945418134891, 10.6448589970651,
- 10.6840679690419, 10.7154810707193

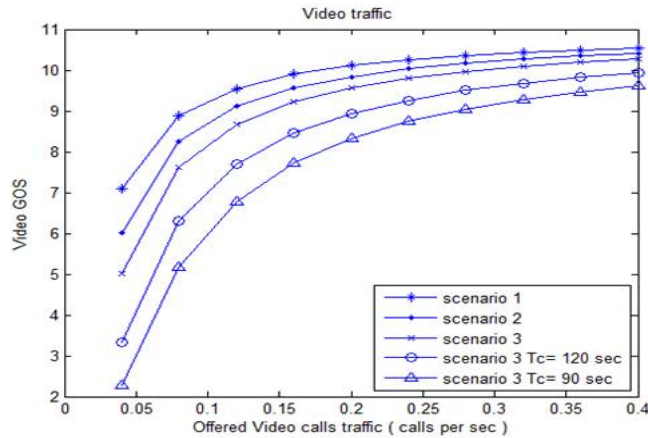


Figure 4: Video GoS vs. offered video calls/sec

	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1
Case 1	10.1094 4	10.5481 2	10.6973	10.7724 4	10.8176 9	10.8479 3	10.8695 7	10.88 582	10.8984 6	10.908 59
Case 2	9.84045	10.4112 9	10.6056	10.7034 9	10.7624 5	10.8018 6	10.8300 5	10.85 122	10.8677	10.880 89
Case 3	9.57195 1	10.2745 2	10.5139 2	10.6345 5	10.7072 2	10.7557 8	10.7905 3	10.81 662	10.8369 3	10.853 19
Case 4	8.93332 1	9.94031 4	10.2880 9	10.4640 7	10.5703 2	10.6414 2	10.6923 3	10.73 058	10.7603 7	10.784 24
Case 5	8.32096	9.61183 1	10.0646 6	10.2949 2	10.4342 5	10.5276 2	10.5945 4	10.64 486	10.6840 7	10.715 48

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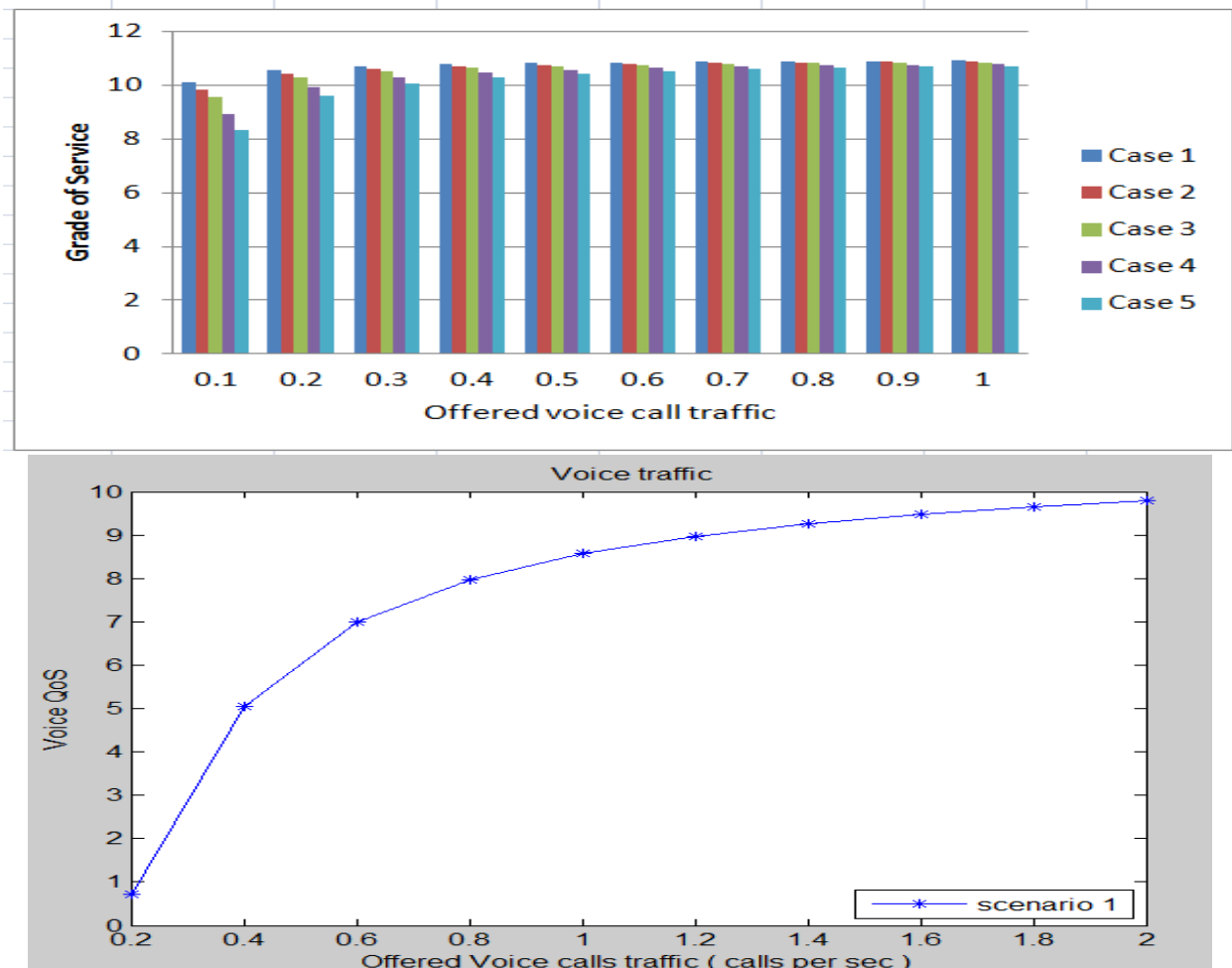


Figure5: Voice traffic: new and hands off calls are treated equally

Increasing the threshold value, both curves have a diminishing course. In the case of CBP, this is due to the higher probability to be admitted into the system, since more obtained values of RP can be considered; for the CDP, there will be more passive reservations (on more cells) so, also in this case, values below 0.1 are obtained. For higher values of R, there is a general increasing trend. The number of available channels remains the same for the CBP, so less MH can enter into the system; for the CDP, a lower number of passive reservations are made, with a higher probability of finding low resources. The following graph shows the results obtained. It is inferred that the call blocking has decreased for the algorithm with LP-RR when compared to the previous algorithm.

## V. CONCLUSION

The task of ensuring the admission of more user calls in the midst of scarce radio resources is a challenging one in a wireless network. For better resource utilization, the admission strategy adopted should ensure that the quality of ongoing calls is not affected or degraded. Adopting a certain CAC scheme to solve this complex task requires taking into consideration the nature of traffic (homogeneous or heterogeneous) and the cell environment (single-cell or multi-cell). The number-based scheme is similar to the FDMA/TDMA technique and is not suitable for emerging 4G wireless network. Similarly, the local scheme which takes note of local cell information only, without considering the impact of other-cells on the session is equally not suitable for NGWN having diverse user applications and different access techniques co-existing seamlessly. With the growing interest in data and multimedia services, single-class CAC

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Vol. 6, Issue 6, June 2017

schemes are no longer sufficient and as a result, multiple-classes of service CAC schemes are more relevant, especially in 3G and beyond networks.

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