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Call Admission Control in Cellular Network

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ABSTRACT*:* A call admission control (CAC) algorithm used for WCDMA prioritized uplink for UMTS, which combines QoS tolerance and service differentiation by priority for voice, data, multimedia. This CAC algorithm gives preferential treatment to high priority calls, such as soft handoff calls, by reserving some bandwidth margin (soft guard channel) , Power consumption, no. of users (load) to reduce handoff failures. In addition, queuing is also used to enhance the service quality. The algorithm uses the effective load as an admission criterion and applies different thresholds for new calls, handoff calls, bandwidth requirement, power consumption. Finally, the study considers three types of services: voice, data and multimedia calls. Use of CAC algorithm indicate that this algorithm reduces the drop of handoff calls and increases the total system capacity and performance; hence the Grade of Service (GoS) of the system can significantly be improved especially in case of high mobility environments.

Keywords: No. of users(load), Bandwidth, Power Consumption, CAC, UMTS, W-CDMA, QOS.

I. INTRODUCTION

Now a days Third generation radio communication systems are designed to offer multimedia services, including voice and video telephony and high-speed Internet access. In Universal Mobile Telecommunication System (UMTS), the radio interface is based on the Wideband Code- Division Multiple Access (W-CDMA) technology. UMTS WCDMA is a Direct Sequence CDMA system (DS-CDMA). WCDMA has two basic modes of operation: Frequency Division Duplex (FDD) and Time Division Duplex (TDD). In the FDD mode, uplink and downlink transmissions use different frequency bands while for the TDD mode, uplink and downlink transmissions can be implemented on unpaired bands but separated by a guard period. In this paper DS-CDMA (FDD) is considered [1].

The measurement of the resource capacity in a spread spectrum system is distinct from conventional TDMA/FDMA systems. In conventional TDMA and FDMA systems such as IS-54 (TDMA) and GSM (hybrid TDMA/FDMA), the number of traffic channels are fixed. It is determined by the number of time slots in the TDMA system or by the number of non-overlapping frequencies in the FDMA system. The spread spectrum system, such as WCDMA, does not have a fixed number of channels. Instead, the capacity of the CDMA system is limited by the total interference the system can tolerate. Such a system is referred to as an interference-limited system. Each additional active mobile user will increase the overall level of interference. Normally, the interference level increases rapidly when the system load reaches a certain level. Users with different traffic profiles and attributes such as the service rate, the signal to-Interference ratio (SIR) requirement, media activity, etc. introduce different amounts of interference to the system. These factors are especially important in 3G wireless networks that support multimedia services.

The coverage of WCDMA is assumed uplink limited in high-load scenarios. The capacity of DS-CDMA networks depends on the reverse link (uplink) rather than the forward link (downlink). Uplink call admission control strategies play a very important role in the performance of CDMA systems as it directly controls the number of users in a cell and thus limit the interference in the system. In this paper only the uplink direction is considered.

With desired features such as high system capacity (soft capacity), low power transmission, soft handoff, multipath mitigation, and interference suppression [1], code-division multiple access CDMA) has been adopted for third-generation wireless communication systems. The third generation wideband CDMA cellular system must be able to support integrated services with differentiated quality-of-service (QoS) requirements. Thus, a sophisticated call admission control (CAC) is needed so that the system can satisfy various QoS constraints such as the forced termination (drop call) probability for handoffs and the outage probabilities for different services, and maximize the spectrum utilization[6].

II. REQUIREMENTS FOR CAC SYSTEM

1. Limit the interference
2. QoS Requirements
3. To support multimedia services
4. Fast internet access

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5. Voice and Video telephony
6. Signal Quality
7. Call Dropping Probability
8. Packet-Level Parameters
9. Transmission Rate

III. OVERVIEW OF CAC

The main function of call admission control algorithm is to limit the interference by controlling the number of new call accepted in the network. CAC need to perform separately for uplink and downlink transmissions as the traffic load offered by the uplink and downlink transmissions is different from each other. The uplink and downlink admission control requirements must be fulfilled by each new user while entering into the system. For high-speed networks such as asynchronous transfer mode networks and wireless networks Call Admission Control has been intensively studied in the last few years. CAC becomes much more complicated in wireless networks Due to users , mobility.

The call dropping happens in the network in most of the case when , accepted call that has not completed in the current cell may have to be handed off to another cell. During the process, the call may not be able to gain a channel in the new cell to continue its service due to the limited resource in wireless networks[2]. Thus, the new calls and handoff calls have to be treated differently with priority in terms of resource allocation. Since users tend to be much more sensitive to call dropping than to call blocking, handoff calls are normally assigned higher priority over the new calls[12]. Handoff priority-based CAC schemes can be classified into two broad categories.

A. *NCAC (Number based)*

NCAC based on a predetermined threshold value of number of users in the system. The QoS requirement, in terms of bit-error-to interference ratio, for the number-based call admission control schemes (NCAC), is mapped into a maximum number of simultaneous users that can be accommodate in the system.

B. *ICAC (Interference based)*

ICAC algorithm consider the SIR as the determinant parameter in accepting or rejecting a new call. Those algorithms are commonly called Interference-CAC (ICAC). Based on previous studies, the interference-based schemes can be further classified into:

i. *WIDEBAND POWER-BASED CAC*

This method accepts the call only if the total interference does not exceed a predefined threshold and computes the increase in the interference (power) caused by the admission of a new user in the cell in uplink [3].

ii. *THROUGHPUT BASED CAC*

A throughput-based CAC algorithm accepts the call only if the total load does not exceed a predefined threshold and computes the increase in the load caused by the admission of a new user in the cell in uplink[3].

iii. *SIGNAL TO NOISE INTERFERENCE BASED CAC*

This algorithm computes the minimum required power for the new user and accepts it if it is not below a predefined minimum link quality level.

IV. PRINCIPLE

Fig 1 shows flow chart for handoff prioritization algorithm which is basic logic and fig. 2 shows priority algorithm depending upon three types of services as voice , media , data.

i. Estimate load factor threshold (in term of No. of user, BW, Power consumption)[4]
ii. Calculate load increase of the arrived call and the current cell load factor before accepting the arrived call.[1]
iii. After calculating the current load of the target cell, it is compared with the load factor threshold of the arrived call.

If the current cell load factor plus the load increase is less than or equal the required load factor threshold for the arrived call, then the arrived call can be admitted to enter the target cell. Otherwise, the arrived call is queued or rejected based on queue availability. Queued soft handoff calls can be accepted if sufficient bandwidth gets available[5], or can be terminated due to timeout.

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V. FLOW CHART FOR CAC HANDOFF PRIORITIZATION ALGORITHM

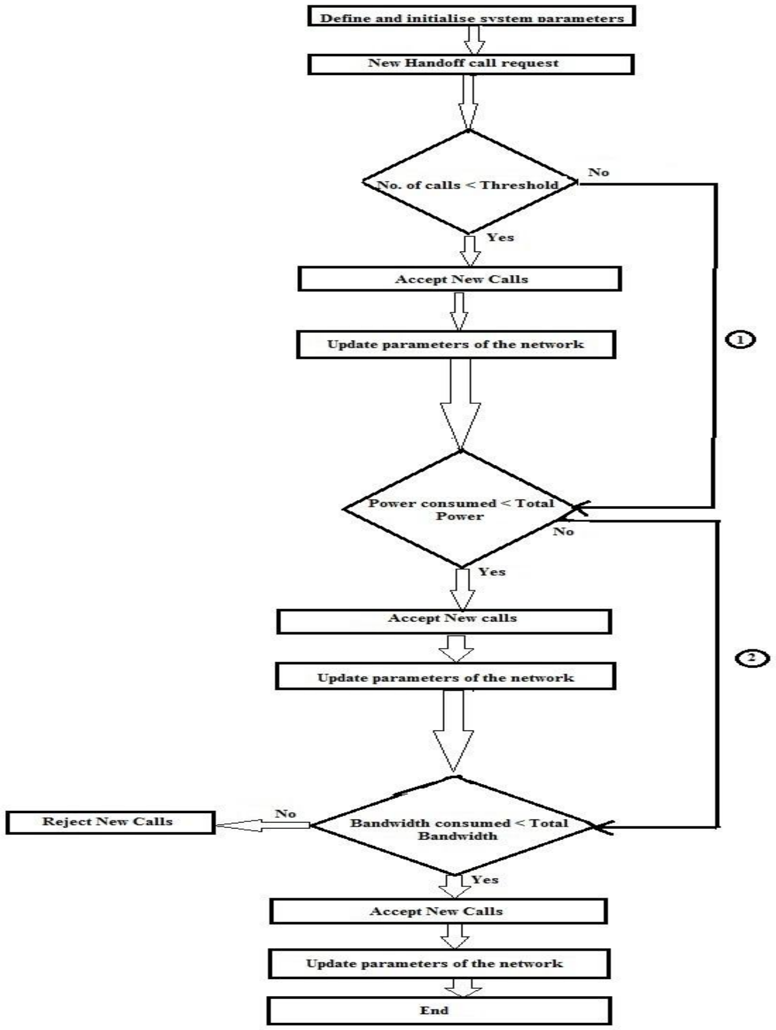

Fig. 1 Flow chart for handoff prioritization algorithm

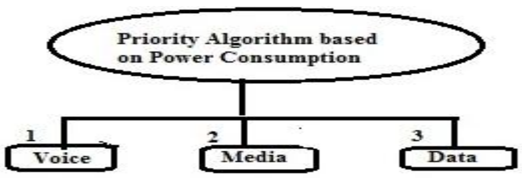

Fig. 2 Priority based flow chart using power consumption

VI. APPLICATIONS OF CAC SYSTEM

1. Simplicity and reliability.
2. Reduced Programming difficulties.
3. Discontinuities of services is avoided.
4. Multiple call request can be handle at the same time.
5. Optimum utilization of cellular network such as- bandwidth,
6. No. of call capability, power consumption.

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7. Assured QoS.
8. Reduces the drop handoff calls
9. Increases the total system capacity
10. Hence the GoS and the system performance can significantly be improved especially in case of high mobility environments.

VII. CONCLUSION

Call admission control is a very important measure in CDMA system to guarantee the quality of service for the communicating links. In wireless networks multimedia traffic will have different QoS requirements. Then, a prioritized throughput based uplink call admission control algorithm for a WCDMA cellular system with perfect power control is presented. To give priority to soft handoff calls, proposed algorithm considers queuing techniques and the idea of 'soft guard channels', which is represented by reserving a small fraction of the cell load for the higher priority calls. The performance of this admission control with different scenarios is studied. Based on simulation results, we conclude that this algorithm reduces the dropped soft handoff calls and improves the overall system capacity.

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