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Adaptive Power Control in WCDMA Wireless Networks

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Abstract-- In third generation (3G) cellular networks, WCDMA is a widely used technique for Quality of Service (QoS) improvement because of high data rate transmission. Power control scheme is very much essential to reduces interference and improve network performance. Existing techniques rarely considered the power controlling scheme for different traffic like CBR and VBR traffic classes. This paper proposes a power control scheme for improving Signal strength as well as provides handoff in WCDMA Wireless networks. According to proposed scheme the transmitted power during the session entry is controlled using Power Control (PC) constrained. The simulation results show that the proposed scheme can significantly increase throughput, residual energy & reduces call blocking probability.

Keywords: 3G, QoS, CBR, VBR, WCDMA, PC

1. INTRODUCTION

In the 3G devices, the WCDMA technique is heavily used for creating a wireless connection. WCDMA technology supports a data rate ranging from 144Kbps to 2Mbps. WCDMA technology provides multimedia services such as the broadband wired networks. When compared with the narrow band CDMA technique, WCDMA is capable of handling services with greater data rate and also capable of allocating multimedia traffic.

1.1 Issues in WCDMA networks

Pilot pollution
HO problem
SHO parameter
Hierarchical cells

1.2 QoS for WCDMA Wireless networks

In a network, QoS is a method of ensuring or warranty related to the service level that will be delivered in an application. Based on the application needs, the QoS factors are taken into account. In communication networks, most of the multimedia traffic need guaranteed

Quality of Service (QoS). Delay jitter, bandwidth, delay, etc are some of the QoS factors [2] [3].The nature of the WCDMA network is soft capacity nature. As a result of it, cell coverage range relies on QoS factors like reliable interference point, spatial mobile user distribution as well as the subsequent time-dependent user traffic intensity [4].

In this paper, Design a Power Control scheme, which control transmitted power with the help of PC constrained for admitted sessions. The rest of the paper is organized as follows: section II gives the details about the related work. The complete detail about proposed methodology is illustrated in section III. Next, section IV gives the results evaluation for the proposed approach, finally conclusions are provided in section V.

2. RELATED WORK

Juan Liu, Wen Chen [1] has presented the major problem for maximizing utility for fair and efficient multicasting in cellular networks. The optimal multicast scheme is developed for two scenarios: Users experiencing nearly equal path losses and different path losses. Especially it has been found that the pure multicast scheme is optimal in the equal path loss. On the other hand, when the users that attempt to receive the same messages are uniformly distributed in a cell, the group multicast scheme should be applied. This result is of group multicast scheme that adapts data transmission rate to the worst case users among a group and it cannot satisfy throughput maximization for all the users distributed in a cell for improving the quality of services. However, the number users should be controlled for better QoS performance.

Bijan Golkar [2] has proposed Resource Allocation in Autonomous cellular Networks and developed a Network Clustering scheme in which scheduling cell is defined by a set of coordinating Base Stations (BS). Proposed approach and each terminal can communicate with more than one BS in the scheduling cell. Resource Allocation across the scheduling cell is distributed. This means that each scheduling cell is performed without knowledge from previous work. However, Power control is still an area to work thoroughly in case of autonomous cellular networks.

Mohamed Khadim Karry and Yasir khan [3] have proposed Evaluation and Comparison of Resource Allocation strategies for new streaming services in wireless cellular networks. There are two categories of services in wireless cellular networks. In first category, there are variable bit rate (VBR) and constant bit rate (CBR) and in the other category, streaming call (video, voice, broadcast) is given that is used in current generation based on QoS and demand of user. However, there is delay in the scheme.

N. Mohan and T. Ravichandran [4] have proposed to design a new CAC algorithm with power control for multiple services like voice, video and data for multiclass users. It determines the optimum set of admissible users with optimum transmitting power level, so as to minimize the interference level and call rejection rate. In addition to this, an adaptive scheduling scheme to allocate optimum rate for each traffic queue is proposed to minimize the scheduling delay. The proposed algorithms achieve reduced call blocking probability, and optimum rate with reduced delay. However, there is a delay in the scheme.

Rekha Patil and Dr. A.Damodaram [5] have developed a cross-layer based joint algorithm for power control and scheduling. The multiple access problems are solved via two alternating phases, namely scheduling and power control. They introduced the notion of power control as part of a contention-based multiple access protocol that characterizes successful transmissions depending on a set of signal-to-interference-and-noise ratio (SINR) constraints (which directly translates to quality of service (QoS) constraints on the bit-error rate (BER) at individual receivers). The scheduling algorithm is essential to admit the transmission of static as well as mobile users of multi service classes, in order to eliminate strong levels of interference that cannot be overcome by power control. By

simulation experiments, they evaluate the performance of their algorithm in a set of admissible and non-admissible users and show that power control algorithm converges for a set of admissible users. However, there is a decrease in the power.

Young-Long Chen et al [6] have proposed a novel approach which combines the CAC and power control mechanisms and operates in a centralized control manner. The essence of the proposed centralized call admission control scheme is to combine the two mechanisms and to treat the call admission decision as an eigen-decomposition problem. In order to reduce the computational complexity of the eigen-decomposition problem, the paper proposes an additional scheme, which uses a norm operation rather than direct computation. The proposed scheme, even with the norm approximation, outperforms conventional call admission methods in terms of both its blocking rate and its outage rate. Consequently, the actual SIR of each link in a neighboring base station may not be guaranteed, with the result that outage may occur.

Tajje-eddine Rachidi et al [7] have presented QaPC and QaHO mechanisms as enabling QoS parameters, which are based on the class of service, the bit rate, and the Service Degradation Descriptor (SDD). They have used bit rate, service class and Service Degradation Descriptor for enabling QoS parameters. The proposed QoS aware mechanism significantly improves QoS contract upholding for premium mobile users, as well as increases resource utilization, while improving SHO acceptance. However, there is overload in the system.

3. PROPSED POWER CONTROL SCHEME

Consider a WCDMA network with a single downlink and a Base Station (BS). The BS transmits radio signals to a number of member nodes of the network. For the network operation, the time t is indexed by frames of equal length. New incoming sessions representing connections are indexed in the incoming sequence. As the session arrives, power transmitted from the network is controlled by PC command.

During operation, the transmitted power during the session entry is controlled using the power control (PC) constraint. The PC constraint is developed on the basis of the Signal-to-Interference Ratio (SIR) obtained from the inner closed loop.

Power Control algorithm-

1. The network maintains a SIR_{target} value which is pre defined.
2. After the session i is admitted into the network, SIR_{est} is calculated by

$$SIR_{est}(i) = SF \frac{P_{rxd,i}}{\sigma^2 + \beta I_{in,i} + I_{out,i}}$$

3. The SIR_{est} is compared with the SIR_{target}.
4. If $SIR_{est} > SIR_{target}$ then

   PC sends REQ_POW_RED to transmitter
5. Else If $SIR_{est} < SIR_{target}$ then the

   PC sends REQ_POW_INC to transmitter
   End

4. SIMULATION RESULTS

In this section, proposed Quality of service based Resource Allocation with Connection Admission Control (RACAC) along with Power Control scheme are simulated for Real-time Traffic in WCDMA networks using an NS-2 simulator.

Based on Number of Users-

In our first experiment, we vary the number of users as 18, 36, 54…..108 and measure throughput, Blocking probability and Residual energy. It is observed that the proposed QRAAS scheme has more throughput less Blocking probability and more Residual energy

when compared to the CCACFS scheme.

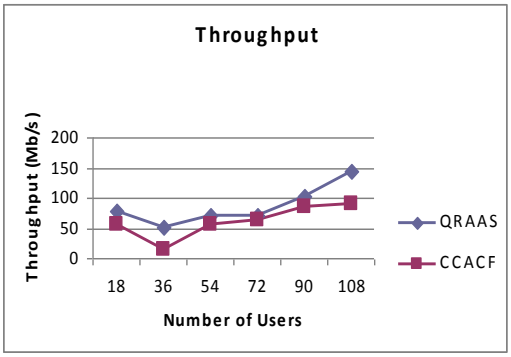

Fig 1: Users Vs Throughput

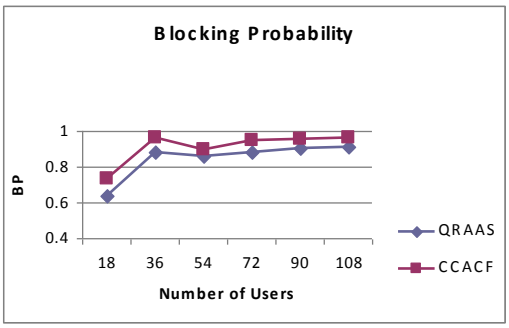

Fig 2: Users Vs Blocking Probability

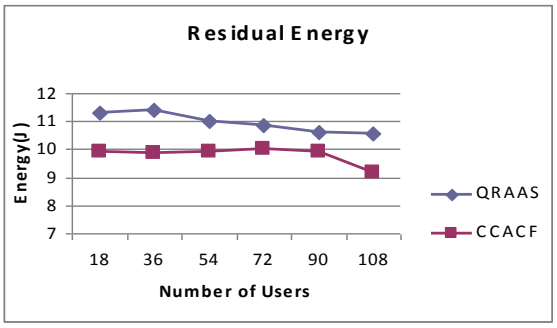

Fig 3: Users Vs Residual Energy

When comparing the performance of the two schemes, we find that QRAAS outperforms CCAC by 41% in terms of throughput, 7% in terms of blocking probability and 9% in terms of residual energy.

5. CONCLUSION

In this paper we proposed an adaptive Power Control (PC) constrained for minimizing interference and providing handoff in 3G-WCDMA Wireless networks. Proposed Power Control scheme shows that when the estimated signal to Interference ratio is greater than the target Signal to Interference ratio then PC command request to reduce the transmitted power. If it is less than the target Signal to Interference ratio then PC command request to increase the transmitted power. Estimated Signal to Interference ratios is calculated with the help of spreading factor, received power ,thermal noise and inter as well as intra cellular noise, whenever an existing and new arrivals hits the power constrained the transmitted power is incremented or decremented with the help of PC command. From our simulation results we have proven that the Adaptive Power Control scheme minimize interference and provides efficient handoff in WCDMA Wireless network by improving the throughput and reducing the power consumption for existing and new arrival users.

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