行政院國家科學委員會補助專題研究計畫成果報告

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計畫編號：NSC90－2416－H－009－010－
執行期間：九十年八月一日至九十一年七月三十一日

計畫主持人：羅濟群教授
共同主持人：
計畫參與人員：謝文川、洪健洲

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執行單位：交通大學資訊管理研究所

中　華　民　國　九十一　年　十　月　十　日

行政院國家科學委員會專題研究計畫成果報告

一個在全球行動通訊系統中以信號干擾比量測為基礎的允入控制演算法

An SIR Measurement-Based Admission Control Algorithm for UMTS

計畫編號：NSC 90-2416-H-009-010
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一、中文摘要

在全球行動通訊系統中，需要允入控制機制來控制是否允許新的使用者加入，能使得系統對使用者要求的傳輸品質能獲得滿足，且又能提高系統的使用率。

先前所被提出來的允入控制機制，對於 handoff 的要求僅保留了固定功率。在本研究中，提出一使用適應性多速率編碼的允入控制機制，可以根據目前的系統狀態來動態調節系統保留頻道的數量，以達到最佳的系統品質(GOS)。本研究並透過模擬來驗證所提出的方法對系統效能的改進。

關鍵詞：允入控制、適應性多速率編碼、全球行動通訊系統

Abstract

Large researches have been focused on the admission control in WCDMA for increasing resource utilization and capacity. Various approaches and techniques have been proposed for different models and environments. Most of existing literature didn't deals separately with new and handoff calls in wireless multimedia networks. A margin resource is reserved for handoff call. To facility the reservation resource efficiency and support higher priority ranking for handoff call, an admission control scheme using Adaptive Multi-Rate mechanism is proposed for improving spectrum utilization. The proposed scheme's performance has been evaluated and compared to the reference case of resource reservation admission control algorithms in simulation. The experiment results show that the radio resource utilization increases and handoff call dropping rate decreases.

Keywords: Admission Control, Adaptive Multi-Rate Codec, UMTS

1. Introduction

Rapid growth of mobile services has resulted in increasing demand for higher data transmission capacity. Third generation mobile systems (3G) has been the hottest topic in the wireless network communication for the past few yeas. Universal Mobile Telecommunications System (UMTS) currently developed by the 3rd Generation Partnership Project (3GPP) will be one of dominant standard among 3G proposals. UMTS specifications are aimed to facilitate the introduction of multimedia services and to provide a seamless evolution from the 2nd telecommunications System, e.g. GSM. UMTS adapts Wideband CDMA (WCDMA) as radio air interface with access speeds of up to 2Mbit/s and support a wide variety of multimedia services such as voice, video conference, e-mail, web browsing and so on. UMTS provides different transmission characteristics and various qualities of service (QoS) requirements services. Each kind of multimedia services has specific Quality of Service (QoS) requirements. How to manage radio resource effectively in order to maximize the capacity has been widely recognized a critical issue in terms of performance of UMTS.

In the previous work, large researches have been focused on the admission control in CDMA for increasing resource utilization and capacity. Various approaches and techniques have been proposed for different models and environments. Most of existing literature didn't deals separately with new and handoff calls in wireless multimedia networks. A margin resource is reserved for

handoff call. To facility the reservation resource efficiency and support higher priority ranking for handoff call, we proposed an admission control scheme using AMR mechanism for improving spectrum utilization.

The paper is organized as follows. First, we review the radio resource management architecture in 3GPP WCDMA System. Next, we explain the interference-based admission control algorithm and propose dynamic rate control of speech traffic using adaptive multi rate codec mechanism. Finally, we investigate the performance of the proposed scheme using simulation and conclude this paper.

2. Literature Review

In this section, a brief overview of related literatures will be given. The first subsection introduces the admission control schemes proposed before or presently in use in UMTS.

2.1 Admission control schemes

Zhao Liu et al. [] study the so-called SIR-based approach, which bases admission criterion on an estimate of the residual capacity, defined as $\left\lfloor \frac{1}{SIR_{TH}} - \frac{1}{SIR} \right\rfloor$. The new call request will be accepted by a BS if the SIR of the BS can be guaranteed to be higher than predefine threshold value after accepting the new call. Once a new call accepted, the residual capacity is decreased by one. Jamie Evans et al. [] uses the concept of effective bandwidth to measure the resource availability by modeling the problem as follows: $P\left(\sum_{j=1}^{J}\sum_{i=1}^{N_j} X_{ji} > C\right) \le \alpha$, where Xji is the amount of resources required by user i of class j, C is the total amount of resources and Nj is the number of users in class j.Tthe admission cirteria can be given by $\sum_{j=1}^{J} k_j \ N_j \le C$ where kj is the effective bandwidth of users in class j.

3. The Proposed Scheme

The bit rate of the AMR speech connection in UMTS could be controlled by the radio access network (RAN) depending on the traffic loading on the air and the quality of the speech connections. If high loading situation is happened, the RAN could use lower AMR bit rates of the real-time speech connection by adjusting AMR speech codec to reduce traffic load. In other word, AMR could a flexible distribution of the gross bit rate to source and channel coding and obtain high speech quality for good channel conditions and a high degree of robustness for heavily disturbed environment. The proposed admission control scheme dynamically adjusts the bit rates of real-time conversational users using the adaptive multi-rate codec mechanism.

3.1 The proposed admission control scheme

For each radio resource bandwidth request, the proposed scheme either accepts it or rejects it. The call admission scheme is presented as flowchart in figure 1. The MS specifies a requirement profile specifying its desired bandwidth, together with whether it is a new or handoff request call. The proposed scheme will be different when the bandwidth is not enough. If there is enough bandwidth available in the current cell, the call will be admitted, and adjust current system load. In case of a non-enough bandwidth situation, there is a provision for admitting handoff call requests by “stealing” capacity from conversational traffic users. The scheme is as follows. In a fully loaded system, the conversational traffic is re-regulated the speech rate of conversational sources. When a handoff call arrives and total traffic exceed system threshold, AMR mechanism is activated. The transmission rate of conversational users is chosen to decrease one level to lower bit rates. The regulation process is repeated until handoff call request is accepted.

Figure 1. Flowchart of the proposed admission control scheme

3.2 AMR-WB codec selection

Conversational calls are put into a queue, and allowed access according to system load. The proposed AC scheme uses AMR-WB to adjust speech rate of conversational users. Two AMR selection methods: random, highest-fit are described below.

Random selection method: All conversational calls are randomly selected without any control. The selection of conversational sources is completely random. When system load exceed pre-defined threshold, all conversational users in queue is chosen to decrease one level until. The adjustment is last until system load + incoming less than pre-defined threshold.

The highest-fit selection method: To facility this highest-fit method, a radio network controller maintains 8 queues for every ARM-WB codec conversational traffic class. On arrival, conversational calls are put in their respective queues according its current codec rate. When system load exceed pre-defined threshold, conversational calls of highest are selected and decrease one level. The adjustment is last until system load + incoming less than pre-defined threshold.

4. Experimental Results and Analyses

To evaluate the system performance of the proposed admission control scheme, three performance metrics are chosen to observe.

Average Throughput: The absolute number of transmitted packets for a service at a certain call-arrival intensity was calculated and present as the absolute number of kbits per user for each service[].

Outage Probability: Outage probability was defined as the probability for system to be in a state with a system load value large than the system predefined-threshold. $P_{outage} = \Pr(\eta_{total} > \eta_{threshold})$

Handoff Call Dropping Probability: Handoff Call Dropping probability was defined as $P_{hc\_dropping} = \Pr(T(\eta_{total} > \eta_{threshold}) > 100ms)$

The simulation results are shown in Figures 2-5. By examining Figure 2 and 3, we notice that the proposed scheme is better than Z. Liu's SIR-based CAC algorithm in terms of average throughput and handoff call dropping rate.

Figure 2 depicts the average throughput versus system load. In this figure, the average throughput of Z. Liu's algorithm is almost same when the system load is closed to the threshold. However, if the proposed admission control scheme is operated, the average throughput continuously increases because the bandwidth reserved for handoff call is utilized. The observed improvement is 17 % around even for system load is high (95%). The highest-fit selection obtains the better system utilization than that obtained using the random selection AMR.

Figure 3 shows that the handoff call dropping probability versus system load. The handoff call dropping probability is observed to be lower with the proposed admission control scheme over that with Z. Liu's admission control. The highest-fit selection

outperforms a better performance than that obtained using the random selection AMR.

Figure 4 shows the outage probability versus system load. In this figure, the outage probability is slightly worsen when the proposed admission control scheme is adopted. Since there always exist a trade-off between the outage probability and system throughput. Acceptance of more calls makes outage probability increase. The random AMR selection obtains a better outage probability than that obtained using the highest-fit AMR selection.

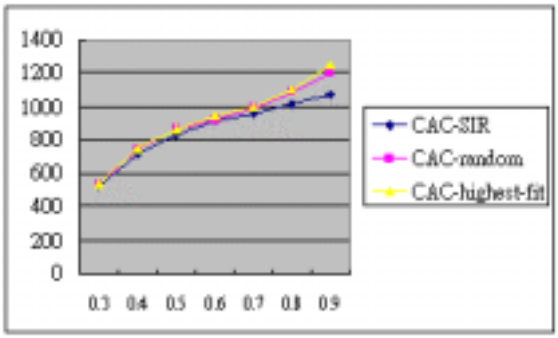

Figure 2. Average throughput versus system load

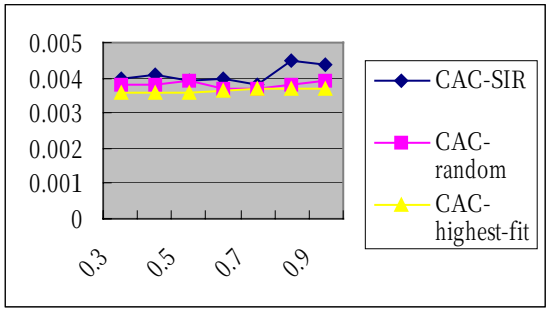

Figure 3. Handoff dropping probability versus system load

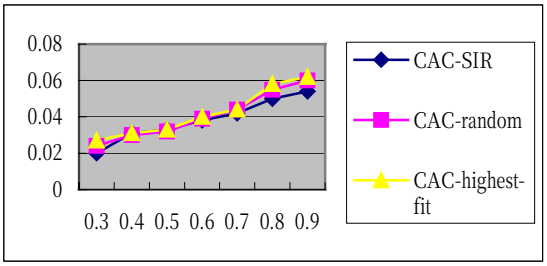

Figure 4. Outage probability versus system load

5. Conclusions

Most of the existing literatures deals with call admission control in wireless multimedia networks. The most import contribution of this work is the development of an integrated framework for higher priority on provisioning of handoff calls and adapted AMR for improving spectrum utilization.

An admission control scheme using AMR has been developed, and its performance has been evaluated and compared to the reference case of resource reservation admission control algorithms. The results show that the bandwidth utilization increases and handoff call dropping rate decreases.

計畫成果自評

目前國內外全球行動通訊系統下的允入控制的相關研究，多半保留了一預先設定之固定功率保留 handoff 的要求，本研究發展出一套同時結合適應性多速率編碼的允入演算法來提升全球行動通訊系統的使用率，本研究的研究方法與研究成果對於相關領域的研究與實作，提供一可行的方針與參考。

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