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CAC Schemes for Capacity Enhancement in WCDMA Systems

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Abstract

To support multiple Service class of different data transmission rate for multimedia application in wireless systems. WCDMA involves orthogonal variable spreading factor (OVSF) code technique. Call admission control (CAC) scheme of the system decides regarding admission of the call. In this paper a new SIR- based CAC scheme for WCDMA system is proposed, so that we can control access of available resource for each service class. A new call request in the system will be accepted, based on the availability of the codes. CDMA system W-CDMA system suffers from code blocking problem to accommodate high data rate calls. This problem can be eliminated by code reassignment technique, finally Markov analysis is used to evaluate the performance of the proposed scheme, considering blocking probability of hand off and new call as performance measure.

Key Words: CAC, DCA, OVSF, System Capacity, WCDMA

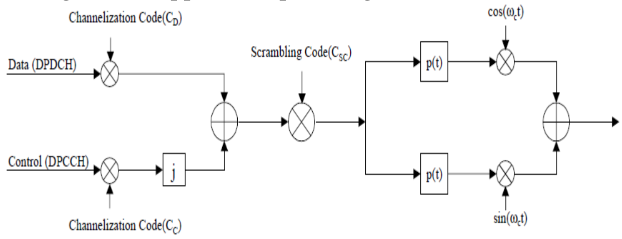
1. Introduction

The intended service for next generation mobile phone users includes services like transmitting high speed data, video and multimedia traffic as well as voice signals. The technology needed to tackle the challenges to make these services available is popularly known as the Third Generation (3G) Cellular Systems which is also known as WCDMA. WCDMA defines two dedicated physical channels which are Dedicated Physical Data Channel (DPDCH) to carry dedicated data generated at layer 2 and above. Dedicated Physical Control Channel (DPCCH): to carry layer 1 control information.Each connection is allocated one DPCCH and zero, one or several DPDCHs. In addition, there are common physical channels which are Primary and secondary Common Control Physical Channels (CCPCH) to carry downlink common channels,

Synchronization Channels (SCH) for cell search and Physical Random Access Channel (PRACH)

2. Spreading And Modulation In WCDMA

WCDMA applies a two-layered code structure consisting of a orthogonal spreading codes and pseudo-random scrambling codes. Spreading is performed using channelization codes, which transforms every data symbol into a number of chips, thus increasing the bandwidth of the signal. In the uplink the data modulation of both both the DPDCH and the DPCCH is BPSK. The modulated DPCCH is mapped to the Q-channel, while the first DPDCH is mapped to the I-channel. Spreading Modulation is applied after data modulation and before pulse shaping. The spreading modulation used in the uplink is dual channel QPSK. Spreading modulation consists of two different operations. The first one is spreading where each data symbol is spread to a number of chips given by the spreading factor. The second operation is scrambling where a complex valued scrambling code is applied to spread signal.



Quaternary Phase Shift Keying (QPSK) is applied for data modulation in the downlink. Each pair of two bits are serial-to-parallel converted and mapped to the I and Q branches respectively. The data in the I and Q branches are spread to the chip rate by the same channelization code.

3. Multicode and OVSF-CDMA

CDMA users can also transmit and receive at higher data rates by using Multiple number of orthogonal constantspreading factor (OCSF) codes, Or An orthogonal variable-spreading-factor (OVSFF) code, or A combination of both. Recursive generation of higher-dimensional OVSF codes from lower-dimensional OVSF codes can be depicted using a code-tree structure as shown in Fig.2. In order to identify the codes in the tree without ambiguity, each code is assigned a unique layer number and a branch number. The code layers are numbered sequentially from bottom to top, starting from. Thus, a higher-layer code has a lower dimension than a lower-layer code. As shown in the top left half of the code tree, two codes of layer 3 can be generated recursively from their mother code of layer 4.

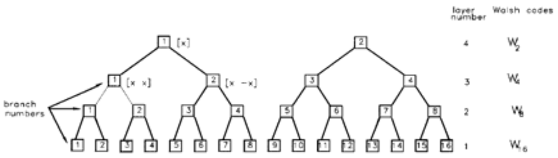


Fig 2 Tree structure of OVSF code

4. Code Blocking in OVSF

OVSF code blocking as the condition that a new call cannot be supported although the system has excess capacity to support the rate requirement of the call. In MC-CDMA, k mutually orthogonal leaf codes are use support a call of data rate kR b/s. However, in OVSF-CDMA, the system may not be able to support a user requesting kR b/s even though k leaf codes are vacant.

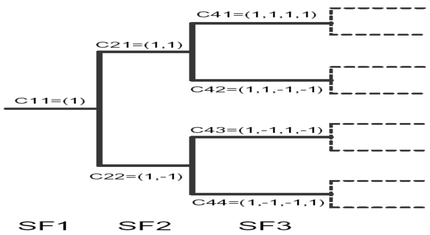


Fig 3 The tree of orthogonal codes

Figure 2.3 shows an example where codes (2, l), (1,3), and (1,5) are already assigned. Thus, the capacity used is 4R b/s. Assuming an ideal code-limited (single-cell) scenario, the system can support a maximum capacity of NmaxR b/s, since there are Nmax leaves and each leaf supports R b/s. Hence, the unused capacity is (8-4)-4R b/s.

5. CAC Schemes for Capacity Enhancement

Genera1ly dropping of on-going calls is more critical than the blocking of new calls, so in CAC schemes we generally employ channel (or code) and power reservation method to reduce the blocking probability of hand-off calls. When a new call arrives, the system has to determine whether to accept the call or not. These admission decisions are performed by call admission control (CAC). CAC belongs to the resource management category and is widely being investigated in many other researches as well. a new CAC scheme for WCDMA system is proposed. It also contains CDMA capacity evaluation and code assignment problem. The proposed scheme consists of handoff and new call admission controls. For each service class, handoff and new call admission controls are considered with different priorities. The handoff call admission control process precedes that of the new call's admission control process. Finally, we evaluate the performance of the proposed scheme by using the Markov analysis. CAC has been extensively studied in wire line networks as an essential tool for congestion control and QoS provisioning. Different aspects of CAC design and performance analysis, particularly in the context of broadband integrated service digital network (B-ISDN) based on asynchronous transfer mode (ATM) technology. However, the problem of CAC in wireless networks is more sophisticated due to the unique features of wireless networks such as channel multiple access interference, channel impairments, handoff requirements, and limited bandwidth. CAC in wireless networks has been receiving a great deal of attention during the last two decades due to the growing popularity of wireless communications and the central role that CAC plays in QoS provisioning in terms of the signal quality, call blocking and dropping probabilities, packet delay and loss rate, and transmission rate.

6. CAC and QOS PARAMETERS

1. **Signal Quality**: CAC is essential to guarantee the signal quality in interference-limited wireless networks. For instance, CDMA wireless networks have a soft capacity limit so that the more loaded the network is, the more deteriorated is the signal quality for users in terms of the interference level or the signal to interference ratio (SIR). Hence, CAC schemes admit users only if it can maintain a minimum signal quality to admitted users (including the new call and existing calls). In this case, the admission criterion can be the number of users (per cell and/or per group of neighbor cells), interference level or SIR, total transmitted power by BS, or received power by either BS or the mobile station.

2. Call Dropping Probability: Since dropping an active call is usually more annoying than blocking a new call, CAC is employed in bandwidth-limited wireless networks to control the handoff failure probability (*Phf*). This can be implemented by reserving some resources for handoff calls exclusively. The admission criterion can be either the number of users (per class in a multiple-class system) or an estimate of handoff failure probability. Resources availability can also be used as a criterion for admission. Whatever the used admission criterion, handoff calls receive less stringent admission conditions compared with a new call, which might lead to an increase in the new call blocking rate (*Pb*).

3. Packet-Level Parameters: When packet- oriented services are provided by wireless networks, network overloading can cause unacceptable excessive packet delay and/or delay jitter. The throughput level at the network or user level can also be dropped to unbearable levels. Therefore, CAC should be used to limit the network level to guarantee packet-level QoS parameters (packet delay, delay jitter, and throughput). In this case, the number of users, resource availability and/or an estimate of the packet-level QoS parameters can be utilized as an admission criterion.

7. ASSIGNMENT PROCESS

The new proposed call admission control scheme by using power reservation for a typical cell. Let Pmax be the maximum power utilized by the base station to accommodate all the requested calls in system, those satisfy minimum required value of SIR so that total bandwidth acquired. So to give priority to hand off call by BS for the hand-off call requests Considering the power reservation for hand-off calls, (RPi) the reserved power for class- i service can be stated as

$$RP(i) = \frac{\lambda_{HO}}{\lambda_{HO} + \lambda_{New}} \cdot P_{\max} .$$

Where λHO is average hand off call arrival rate, and λNew is the average new call arrival rate. Where Pmax is the maximum power of base station. Let Pi ,0≤i≤N-1, be the power of each user in the class-i, then for the system to in the state S.the available power is given by

$$R_p(S) = P_{\max} - \sum_{i=0}^{L-1} P_i n_i$$

where n_i denotes the number of class- *i* users in system. There fore now we define a power margin function that represent the difference between available power and reserved power. When the system is in state S. let $MP_{n(S,i)}$ denote power margin function for class-i new call as $MP_n(S,i) = R_p(S) - RP(i)$

Since there is no power reservation for new calls, therefore no power margin is required for handoff calls. So the handoff call is admitted when there is enough available power in the system and the new call is admitted only when $MP_{n(S,i)} \geq Pi$

8. Simulation and Result

The primary performance measure are the handoff failure probability and the locking probability of new call arrival. Let PBHO(i) be the blocking probability of class-i hand-off call.

The blocking probability of a class-i hand-off call, PBHO(i) is

$$P_{BHO}(i) = \sum_{s \in S_{\max(i)}} P_s \left(\frac{\lambda_{i0}}{\lambda_{i0} + \lambda_{i1}} \right)$$

Arrival rate of class- i call is denoted as λij. where j = 0 for hand-off calls and j =1

for new calls, and the new call blocking probability of class- i calls as

$$P_{BNew}(i) = \sum_{s \in S_{\max(i)}} P_s \left(\frac{\lambda_{i1}}{\lambda_{i0} + \lambda_{i1}} \right) + \sum_{s \in S_{\max(i)}} P_s (1 - a_i) \left(\frac{\lambda_{i1}}{\lambda_{i0} + \lambda_{i1}} \right)$$

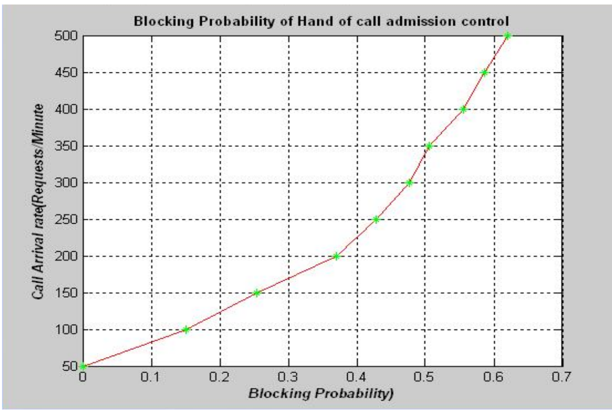


Fig 4 Simulation of the handoff call admission control scheme

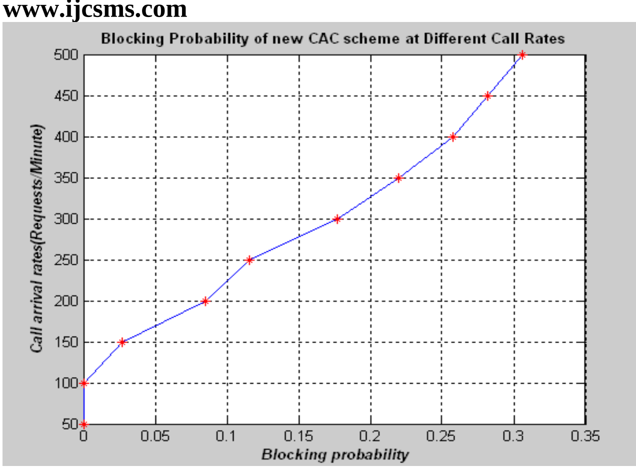


Fig 5 Simulation for the new call admission control scheme

As we have seen when we are using the old CAC scheme the blocking probability is below 0.6, but when we are using new CAC scheme the blocking probability is below

0.35 which is better than the previous technique and as the blocking probability of call decrease the capacity of the system will increase

9. CONCLUSION AND FUTURE SCOPE

I have purposed a new power reservation CAC scheme and demonstrated its performance. Simulated results are obtained by matlab software. From the above result for different traffic model and service class I found that our purposed scheme performs equivalent to bandwidth reservation scheme in the case when the two service classes are adjacent to each other. So our purposed scheme performs well for all service classes show that, purposed scheme work reliably under good traffic load condition with lower blocking probability of handoff calls as well as lower service class call. So we can conclude that our purposed scheme can be good choice for resource management, so that more number of user can frequently access the channel which in turns enhances the capacity of mobile multimedia systems such as UMTS/IMT-2000.
Although channel reservation scheme has limitation to work with different service class, but can still work efficiently with certain classes. So in future work channel as well as power reservation schemes can utilized together to design an advance CAC schemes for WCDMA multimedia systems.

10. References

1 F. Adachi, M. Sawahashi, and H. Suda, “Wideband CDMA for next generation mobile communications systems,” IEEE Commun. Mag., vol.36, pp. 56–69, Sept. 1998

2. I. Chih-Lin et al., “IS-95 enhancements for multimedia services,” Bell Labs. Tech.
J., pp. 60–87, Autumn 1996.

3. W. S. Jeon and D. G. Jeong, “Call Admission Control for CDMA Mobile Communications Systems Supporting Multimedia Services”, IEEE Trans. Wireless Communications, Vol.1, No.4, Oct. 2002

4.P. Ramanathan, K. M. Sivalingam, P. Agrawal, and S. Kishore, Resource allocation during handoff through dynamic schemes for mobile multimedia wireless networks,” in Proc. IEEE INFOCOM ’99, 1999, pp. 1204–1211.

5. A. Capone and S. Redana, “Call admission control techniques for UMTS,” in Proc. IEEE VTC 2001-Fall, Oct. 2001, pp. 925–929.

6. W. S. Jeon and D. G. Jeong, “Call Admission Control for CDMA Mobile Communications Systems Supporting Multimedia Services”, IEEE Trans. on Wireless Communications, Vol.1, No.4, Oct. 2002.

7. T. Minn and K.Y. Siu, “Dynamic Assignment of Orthogonal Variable Spreading Factor Codes in WCDMA”, IEEE J. Select. Areas Communication, vol.18, pp.1429-1440, Aug. 2000

8. Z. Liu and M. El Zarki, “SIR-based call admission control DS-CDMA cellular systems,” IEEE J. Select. Areas Commun., vol pp. 638–644, May 1994

9. J. Wang, Q. A. Zeng and D. P. Agrawal, “Performance Analysis of Preemptive and Priority Reservation Handoff Scheme for Integrated Service-Based Wireless Mobile Networks”, IEEE Transactions on Mobile Computing, vol.2, No.1, pp.65-75, Mar.2003

10. S. M. Shin, C.–H. Cho and D. K. Sung, “Interference-based channel assignment for DS-CDMA cellular systems”, IEEE Trans. Vehicular Technology, vol.48, pp.233-239, Jan. 1999.

11. D. Hong and S. S. Rappaport, “Traffic model and performance analysis for cellular mobile radio telephone systems with prioritized and non prioritized handoff procedures,” IEEE Trans. Veh. Technol., pp. 77
Aug. 1986.

12. C. Huang, “An analysis of CDMA 3G wireless communications standards,” in Proc. IEEE VTC ’99, May 1999, pp. 342–345.