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Capacity Utilization and Admission Control in 802.16e WiMAX

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Abstract

As the network operators are expected to offer plenty of services, users in the network will have varied QoS needs. The unpredictable nature of the network and the exponential growth in traffics, there is a need for intelligent Call Admission Control (CAC) technique that simultaneously manages traffic and bandwidth. In this paper an efficient CAC scheme for mobile WiMAX that satisfies bandwidth and QoS requirements have been proposed. The bandwidth partition approach is undertaken in which the bandwidth is partitioned as constant bit rate for UGS, variable bit rate for rtps and nrtps, handover for handover traffics and shared for all traffics. Simulation is done to evaluate and compare the performance of scheme. The features of this scheme allow reduction in call dropping and blocking probability of connections and improvement in the bandwidth utilization of system.

Keywords: WiMAX, Quality of Service, call admission control, call blocking probability, call dropping probability, bandwidth utilization, partition base.

1. Introduction

WiMAX, standardized as IEEE 802.16 is used for providing wireless access with high data rates, high mobility and wide coverage. Traffic expected in WiMAX network is classified into five service flows: Unsolicited Grant Service (UGS), real time polling service (rtPS), extended real time polling service (ertPS), non real time polling service (nrtPS) and best effort (BE) [10]. Proper and efficient policy is needed on how these traffics could be admitted to network so that bandwidth could be managed. CAC is one of such policies. In this paper, CAC scheme is proposed for mobile WiMAX in PMP mode. The partition base bandwidth management scheme for new and handover traffics is used which is implemented in the BS. Its performance is compared with partition base scheme in [5]. The rest of paper is organized as follows: Section 2 discusses previous work, section 3 focuses on system model, section 4 deals on proposed CAC scheme, section 5 presents simulation parameters and results and section 6 has the conclusion of the paper.

2. Related Work

There have been several studies focussing on providing QoS in IEEE 802.16 networks. In [7] a conventional bandwidth allocation CAC algorithm was proposed which decides if the QoS for the particular connection can be satisfied at BS. In [8] work of [7] was improved by considering the packets delay. In [9] the dropping probability was reduced by using fuzzy logic. In [3] CAC using dual partition (CBR traffics and VBR traffics) in mobile WiMAX has been proposed. In [4] bandwidth was partitioned into three: CBR, VBR and HO traffics. The blocking and dropping probabilities of PB-BM were less than AB-BM (adaptive base bandwidth management). In [2] dynamic CAC and bandwidth reservation scheme was proposed to simultaneously improve utilization efficiency of network resources and guarantee QoS for admitted connections. In [5] fuzzy logic partition-based CAC (FZ-CAC) scheme was proposed. It allocates bandwidth with dynamic percentage to CBR, VBR and HO portion. To improve the service flow acceptance and reduce blocking and dropping probabilities an efficient CAC algorithm is presented in this paper. The algorithm in [5] was developed and compared with the proposed system.

3. System Model

The system model used in this work has one BS and neighbouring BS for generating HO traffics. SSs are uniformly distributed around coverage areas of BSs. For simulation, Hilly terrain environment with moderate to heavy tree density that reflects category A Erceg model [10] has been used. Total path loss (P_{loss}) between SS and BS can be expressed as

$$P_{loss}=20\log_{10}\left(\frac{4\pi d_o}{\lambda}\right)+10\gamma\log_{10}\left(\frac{d}{d_o}\right)+6\log_{10}\left(\frac{f}{2000}\right)-10.8\log_{10}\left(\frac{h}{2}\right)+s, \quad d>d_o. \tag{1}$$

where d_o is reference distance (100m), λ is wavelength, γ is path loss component, d is distance between SS and BS which is greater than d_o, f is transmission frequency, h is BS antenna height and s is shadowing factor. Signal to noise (SNR) ratio can be obtained as [1]:

$$\text{SNR}=\frac{\varepsilon\theta\vartheta}{PL*\psi}, \tag{2}$$

where ε signifies transmitted power from BS, θ is antenna gain of BS, ϑ is antenna gain of SS and ψ is receiver sensitivity. The SNR value calculated from (2) is then used in determining required coding and modulation scheme and coding rate as given in Table 1 [6].

Table 1 Receiver SNR in dB

S/N	Modulation	Coding rate	SNR(dB)
1	QPSK	½	5.0
		¾	8.0
2	16-QAM	½	10.5
		¾	14.5
3	64-QAM	½	16.0
		2/3	18.0
		¾	20.0

For calculating blocking probability (P_b), J/Z ratio is used where J is the number of traffics blocked and Z is the total number of traffics that requested the network entry. Similarly, dropping probability (P_d) can be computed as P_d=x/y where x is number of unsuccessful handovers and y is the total number of handover traffics that requested the bandwidth.

4. Call Admission Control Policy

In proposed scheme the bandwidth is partitioned into four portions. All the CBR traffic is admitted in CBR portion, all the rtps and nrtps traffic is admitted in VBR portion, handover traffic is admitted in HO portion and whenever there is insufficient bandwidth in a CBR, VBR or in HO portion, the bandwidth is allocated in shared portion. The arrival and departure of traffic follows Poisson process. The departure rate is one-tenth of arrival rate of traffic. When traffic is admitted, bandwidth is updated by subtracting required bandwidth to give QoS of the service involved from remaining bandwidth of the portion. However when drop of HO traffic occurs, fuzzy logic is implemented in HO portion for adjusting bandwidth by borrowing from either CBR or VBR portion (depending upon which has greater available bandwidth) and update all portions before next traffic. Mandani fuzzy model is used in this paper.

5. Simulation Parameters and Result

Proposed model is simulated in matlab. Parameters used in simulations are shown in Tables 2 and 3.

For analysing the performance of proposed scheme traffic of 200 service flows is undertaken. In this scenario we have 150 new traffics and 50 HO traffics. The blocking probability is evaluated every 20 calls per minute. It can be shown in Figure 1 that blocking probability of proposed scheme is reduced as compared to previous scheme [5]. Figure 2 indicates that proposed scheme can also reduce dropping probability. Figure 3 shows the amount of CBR, VBR and HO allocations in proposed scheme.

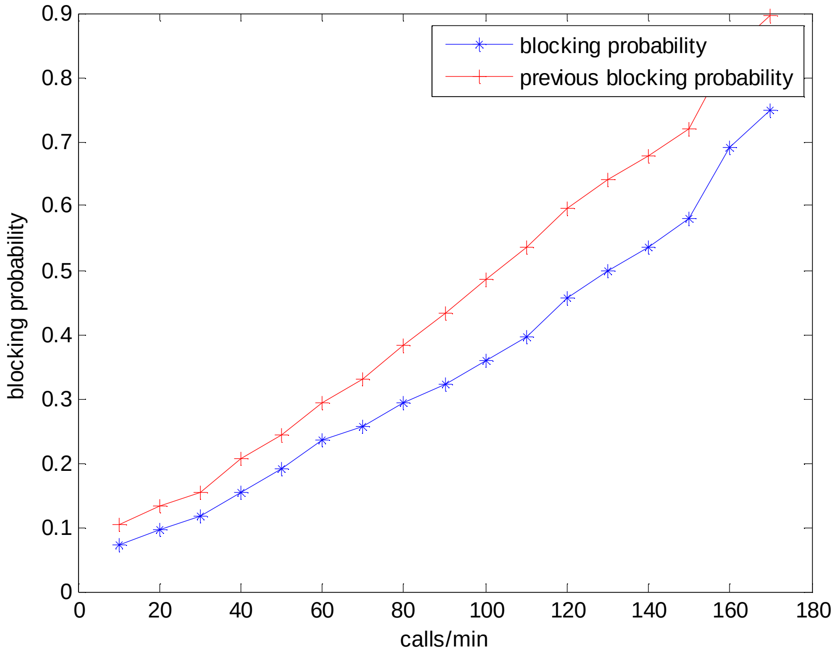

Figure 1 Blocking Probability

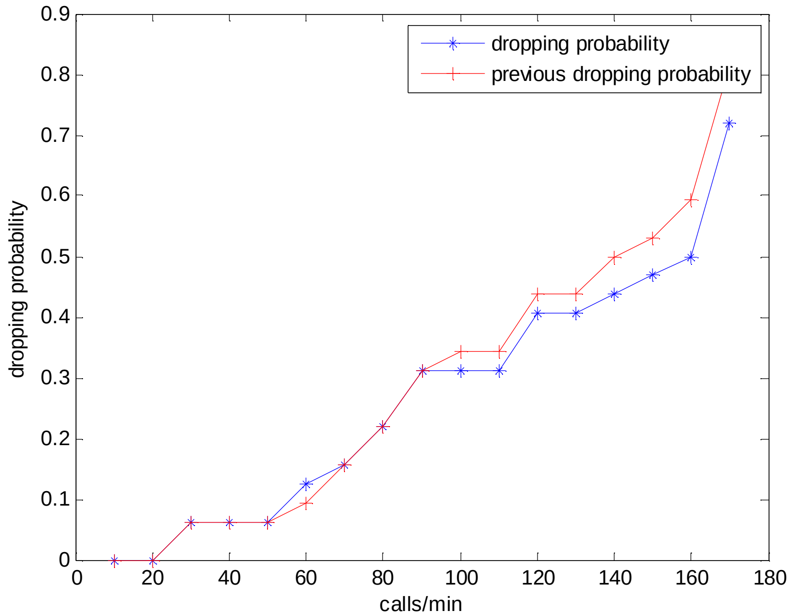

Figure 2 Dropping Probability

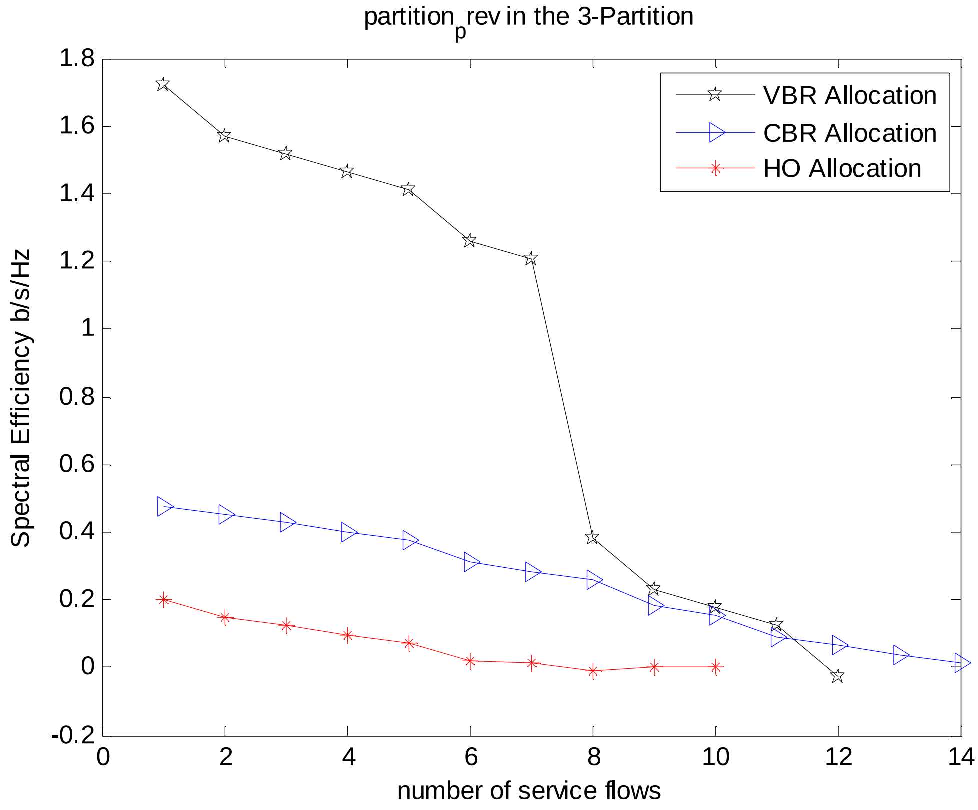

Figure 3 CBR, VBR and HO allocation

Table 2 Simulation Parameters

Parameter	Settings
Bandwidth	5 MHz
Total Capacity	12.6 Mbps
Shared portion	10%
Handover portion	10%
CBR portion	15%
VBR portion	65%
Modulation scheme	QPSK, 16-QAM, 64-QAM
Transmission frequency	2.5 GHz
Path loss exponents	4.75
Shadowing component	8.9
BS transmitting power	43 dBm
BS antenna gain	15 dBi
Receiver sensitivity	-111.1 dBm
Receiver antenna gain	-1.0 dB

Table 3 Traffic types used in simulation

Class	Type	Max	Avg	Min
Traffic 1	UGS	64	64	64
Traffic 2	UGS	20	20	20
Traffic 3	Rtps	400	380	320
Traffic 4	Rtps	82	60	53
Traffic 4	Nrtps	130	126	110
Traffic 5	Nrtps	20000	1870	1600

6. Conclusion

In this paper call admission control scheme was proposed which uses partition base bandwidth scheme. The performance of this scheme was compared with the partition scheme presented in [5]. The results showed that the proposed scheme performs better than the previous schemes in terms of low dropping and blocking probabilities and higher spectral efficiency. This proposed scheme will provide better QoS for both mobile and stationary service flows in the network due to low blocking and dropping probabilities.

References:

[1] B. Sklar, "*Digital Communications: Fundamentals and Application,*" Prentice-Hall, Upper Saddle River, NJ, USA, 2nd edition, 2001.

[2] Chiapin Wang, Wan-Jhen Yan and Hao-Kai Lo, *"Dynamic admission control and Bandwidth reservation for IEEE 802.16e mobile WiMAX networks,"* EURASIP Journal on Wireless Communications and Networking, Vol. 2, pp. 143-163, 2012.

[3] D.S Shu'aibu, S.k.Syed, Yusof, N.Fisal, *"Call admission control in Mobile WiMAX IEEE802.16 with dual partitioning,"* Proceedings of International conference on Intelligent Network and Computing (ICINIC), 2010.

[4] D.S. Shu'aibu, S.k. Syed, Yusof, N.Fisal, *"Partition-Based Bandwidth Management for Mobile WiMAX IEEE802.16e,"* International Review on Computers and Software (I.R.E.C.O.S), Vol. 5, n. 4, pp. 284-293, 2010.

[5] D.S. Shu'aibu, S.K. Syed Yusof, N. Fisal, S.H.S. Ariffin, R.A. Rashid, N.M. Abdul Latiff, and Y.S. Baguda, "*Fuzzy Logic Partition-Based Call Admission Control for Mobile WiMAX,"* International Scholarly Research Network ISRN Communications and Networking, Vol. 1, pp. 989-998, 2011.

[6] IEEE Std. 802.16e, "*IEEE standard for local and metropolitan area networks, part 16:air interface for fixed and mobile broadband wireless access systems, amendment 2: physical and medium access control layers for combined fixed and mobile operation in licensed band and corrigendum 1*" May 2005.

[7] J. Chen, W. Jiao, and H. Wang, *"A service flow management strategy for IEEE 802.16 broadband wireless access systems in TDD mode,"* in

Proceedings of the IEEE International Conference on Communications (ICC'05), pp. 3422-3426, Seoul, Republic of Korea, May 2005.

[8] S. Chandra and A. Sahoo, *"An efficient call admission control for IEEE802.16 networks,"* in proceedings of the 15th IEEE Workshop on Local and Metropolitan Area Networks, pp. 188-193, Princeton, NJ, USA, June 2007.

[9] S. Mopati and D.Sarkar, *"Call Admission Control in mobile Cellular system, using Fuzzy associated memory,"* in proceedings of the 12th International Conference on Computer Communications and Networks (ICCCN'03), pp. 95-100, October 2003.

[10] WiMAX Forum, K. Ramadas, and R. Jain, *"WiMAX System Evaluation Methodology,"* version 2.1, July 2008.