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Reserved Bandwidth For Gateway Relocation To Improve The QoS In Mobile WiMAX Network

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Abstract*:*

The WiMAX Forum supports various scheduling algorithms to identify and classify the heterogeneous traffics. But the scheduling algorithm alone will not achieve the better quality of service in Mobile WiMAX IEEE 802.16e. The call admission control plays an important role especially when combined with scheduling service, as they are intended to manage and guarantee the QoS requirements. Hence we are proposing the Gateway Relocation Call Admission Control (GRAC) algorithm, it just accepts or rejects the Mobile Stations and Priority based scheduling algorithm differentiates the mobile stations with good channel conditions from poor channel conditions, and to differentiate real-time traffics with the non-real-time traffics. For this reason, the network delay reduced while the throughput of a network can be improved compare to implementing one of them alone. In addition, our algorithm implementation also keeps fairness in mind, which diminishes the starvation of non-real-time traffics. Simulation result shows the increase the network performance in terms of throughput; maintain the long-term fairness, and low packet dropping and blocking ratios of real-time traffics.

Keywords*: Scheduling algorithm, resource management, admission control, throughput, quality of service (QoS).*

1. Introduction

WiMAX is short for Worldwide Interoperability for Microwave Access, and it also goes by the IEEE name 802.16. It has the potential to do to wireless broadband Internet access what cell phones have done to phone access.

WiMAX is intended to enable persistent, high-speed mobile internet access as coverage area up to 50kilometers from the radius of the Base Station with the data rate about 70Mbps. It does not requires Line-of-sight between user and base station and operate with the licensed frequency band 2 to 11 GHz. It also defines both the MAC and PHY layers and allows multiple PHY-layer specifications.

WiMAX can support Quality of Service on the wireless domain and interfaces for ATM, IP [4] and also it supports several broadband services like voice over IP (VoIP), video on demand [3] and video conference. The subscriber stations (SS) which is accesses the WiMAX need to ask for a connection to the base station (BS) previous to transmit or receive any data. The BS receives the request then checks the availability of resources which are enough to carry the requested service exclusive of degrading the QoS for other progressing connections. This process is governed by a method known as the call admission control.

Call Admission Control plays an important role in Mobile WiMAX which can also be defined as the mechanism to accept or reject a flow based on the predefined parameter called flow specifications. Some of the CAC algorithms have been proposed in[2],[5],[11] such as Weighted Fair Queuing, Earliest Deadline First (EDF), First In First Out (FIFO) none of the methods achieve better QoS and delay. The Gateway Relocation Call Admission Control (GRAC) algorithm combines the traditional Admission Control and ASN Gateway relocation which reduces the delay. The WiMAX Forum [2] supports various scheduling algorithms to identify and classify the heterogeneous traffics [6]. The proposed Priority based scheduling algorithm differentiates the mobile stations with good channel conditions from poor channel conditions, and also differentiates the real-time traffics with the non-real-time traffics. Hence it reduces the network delay and improves the throughput. Main objectives of our algorithm are to improve the through put, of network to reduce the delay constraints of real-time traffics, and to accomplish fair resource distribution amongst MSSs.

The MSSs are assigned according to their channel conditions and traffic buffers. Particularly, the MSSs which has good channel conditions will have a higher priority and the channel which has poor channel conditions will have lower channel condition, so the network throughput can be increased in view of the fact that MSSs can us higher data rate to transmit. Additionally, the MSSs with real-time traffics will be assigned with a high priority to improve their traffic delays. In addition to the starvation of non real time traffics can also prevented. Implementation of Call Admission Control alone will not provide guaranteed QoS. If we implement CAC as combined with scheduling algorithm we can obtain good QoS in Mobile WiMAX.

This paper is prearranged as follows: Section 2 the proposed GRAC is presented. In Section 3 the priority based scheduling algorithm was presented. In Section 4, we evaluate the performance results. Section 5, concludes our paper.

2. Gateway Relocation Admission Control (GRAC)

The proposed Gateway Relocation Admission Control is the combination of traditional Admission Control and Access Service Network (ASN) Gateway. As aforementioned the Call Admission Control plays an important role in Mobile WiMAX which can also be defined as the mechanism to accept or reject a flow based on the predefined parameter called flow specifications. The traditional Admission Control will not accomplish the mobility management [18]. Hence we are combining the traditional CAC with ASN Gateway Relocation. The relocation is the process of changing the traffic anchor point from one Base Station to another or from one ASN Gateway to another Gateway [24] and it is independent to MS's link layer handover.

The ASN GW relocation may be performed at dissimilar times with different purposes. When a Mobile Station moves from one BS to another BS the handover is occurred. After performing the handover the MS performs ASN GW relocation without delay as a result the number of Anchored MSs can be set aside miniature. It is not a strategy when a MS keeping changing its ASN Gateway and moves fast it may increase the handover delay. On the other hand, it may not be a good approach for all time to relocate an Anchored MS so rapid. On the other hand while more and more MSs are served by two ASN GWs, the load of the system will turn out to be heavy. New users will be blocked and handover users might be dropped additionally. The system performance may be abridged considerably. Thus, performing ASN GW relocation is very important.

In WiMAX standards are particularly decide when to perform ASN GW relocation. In our paper, we think about that the system load is grave so Anchored MSs are required to perform ASN GW relocation. The anticipated GRAC decides at what time to request Anchored MSs to perform ASN GW relocation and it also determines how many Anchored MSs have to be relocated. Subsequent to ASN GW relocation, resources are free and system performance is improved. It is tough to calculate approximately the resource essential in an ASN GW to accomplish the needs of the MSs the ASN GW is at present serving. If the resource in one ASN GW was abundance, the ASN GW may well turn out to be a performance blockage. An additional method is that the number of BSs controlled by each ASN GW can be scaled downwards to put a stop to the resource abundance. Nevertheless, for the reason that the number of BSs controlled by each ASN GW is reduced, these will foundation a lot of inter-ASN handovers. Consequently, this come within reach of will sustain high cost.

The main objective of this paper is to propose a impartial algorithm such that every one ASN GW can establish at what time to request Anchored MSs to carry out ASN GW relocation. The GRAC algorithm will not substitute information among neighbouring ASN GWs. It also does not encompass necessitate of centralized synchronization and every support from further servers. The proposed algorithm combination of traditional Admission Control and Access Service Network (ASN) Gateway to determine as soon as is essential to carry out ASN GW relocation. Hence, it is called Gateway Relocation Admission Control (GRAC).

3. Priority Based Scheduling Algorithm

3.1 Need For Scheduling Algorithm

Let us consider the communication of an IEEE 802.16e system with Point to Multi Point (PMP) mode. The mode has one BS which is positioned at the centre and supports multiple MSSs [9]. As soon as a MSS requires beginning a traffic flow, it should get a permission to initiate a connection from the Base Station. Then only BS can acknowledge the connection if it has a sufficient amount resource to maintain the QoS requirement to the traffic flow; or else, the traffic flow will be dropped. Hence the scheduling should be done with efficient manner.

3.2 Our Proposed Algorithm

In our proposed Priority based scheduling algorithm differentiates the mobile stations with good channel conditions from poor channel conditions, and also differentiates the real-time traffics with the non-real time traffics. The MSSs are assigned according to their channel conditions and traffic buffers. Particularly, the MSSs which has good channel conditions will have a higher priority and the channel which has poor channel conditions will have lower channel condition, so the network throughput can be increased in view of the fact that MSSs can us higher data rate to transmit. Additionally, the MSSs with real-time traffics will be assigned with a high priority to improve their traffic delays. In addition to the starvation of non real time traffics can also prevented.

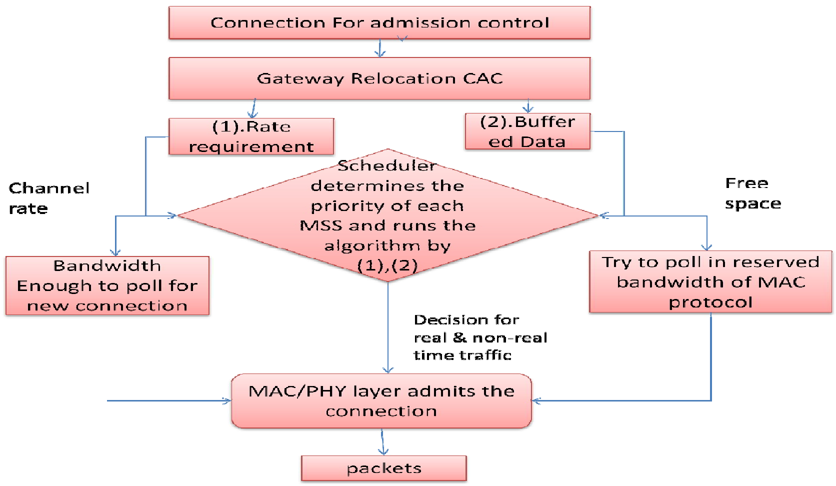

Figure 1: System Architecture

The system architecture of our proposed System architecture is illustrated in Fig 1. The scheduler handles each downlink and uplink sub frame. First the algorithm accepts the connection by our GRAC algorithm. Whilst scheduling each frame, the scheduler will first query the MAC/physical layers for the current channel rate of every MSS and the total free space in slots for the current downlink and uplink sub frame. After that, given the rate requirement and the buffered data of each MSS, the scheduler will estimate its priority.

Founded on these priorities, the scheduler is able to carry out our proposed priority-based scheduling algorithm to determine the bandwidth allocated to each one MSS. Such a decision will be sent to the MAC/physical layers to coordinate free slots intended for transmission. If we have at a standstill free resource, can be distributed to MSSs in accordance with their priorities.

Our proposed algorithm can be implemented by following steps:

1: Let us consider 'n' number of connection.

2: Determine the connection parameters such as b_i, r_i, d_i.

3: Determine the network parameters such as $C_{UL}, C_{DL}, C_{rttps}, C_{nrtps}, f$.

4: Total bandwidth $B_{total} = C_{UL} + C_{DL}$

5: $C_{NRT} = C_{UL} - C_{rtps}$ /* Initiate the connection*/

6: $C_{rtps,new} = C_{rtps} + r_i$ /* connection for new connection*/

7: $C_{nrtps,handof} = C_{nrtps} - r_i$ /* connection for hand off connection*/

8: checking the available resources in terms of bandwidth $r_i = B_{total} - C_{rtps} - C_{nrtps}$

9: connection acceptation of traffic

$r_i \leq B_{total} - C_{rtps} + C_{nrtps}$

10: connection rejection of traffic $r_i \geq B_{total} + C_{rtps} - C_{nrtps}$

11: update $B_{total\ traffic} \leftarrow C_{rtps} + C_{nrtps} + r_i$

Symbols	***Description***
r_i	*Rate requirement*
b_i	*Buffered data*
f	*Frame duration*
d_i	*Maximum delay requirement of* i^{th} *connection in ms*
C_{rtps}	*Capacity of real time traffic connection in bps*
C_{nrtps}	*Capacity of real time traffic connection in bps*
B_{total}	*Total available bandwidth*
C_{UL}	*Number of uplink connection*
C_{DL}	*Number of downlink connection*

Table 1: List Of Parameters

4. simulation results

We presented the performance analysis and it is validated by widespread simulations by using Network Simulator-version 2.28 (ns-2) [16]. We provided the simulation results for both Gateway Relocation Call Admission control and Priority based scheduling algorithm.

4.1Performance analysis:

The parameter which are used for simulation parameters are listed in table II.The WiMAX is based on OFDMA [4] in which a one sub channel will be present in two OFDMA symbols for variation in PUSC of down link (DL) and uplink (UL). Hence the total number of slots per one PUSC frames Ts [3] is given by,

$$T_c = S_c * f/2 \qquad (1)$$

Where S_c is the total number of sub channel, f is the frame duration of DL and UL.

$$T_{total} = T_s / T_d \qquad (2)$$

The frame duration of each channel can determine by,

$$f \leq min\,(d_i / 2) \qquad (3)$$

The bandwidth control equation used to update [11] the data traffic in both the uplink (UL) and downlink (DL) which is shown in below:

$$B = B_{total} \sum_{u=0}^{K} \sum_{v=0}^{L} C_{min}(u, v) \qquad (4)$$

B is available resource in terms of bandwidth. K and L are type of service traffic. C_{min} is Minimum reserved bandwidth for traffic rate connection of u^{th}, v^{th} service class. To schedule the uplink and downlink it is necessary to implement the scheduling along with delay guarantee. That condition is given as follows:

$$b_i \leq [(m_i - 1)\left(1 + \frac{C_{nrt}}{C_{rtps}}\right) - 1] r_i f \qquad (5)$$

Parameters	***Value***
Total number of MSS in one ASN GW	*500*
Standard normal random variable	*(0,1)*
Frame duration	*5ms*
Number of least sample	*50*
FFT size	*1024*
Category of zone	*Partial usage of sub frame with reuse 1*
Modulation schemes	*QPSK3/4,16QAM1/2,64QAM1/2*
Real time traffic	*rtPS*
Non-real time traffic	*Nrtps*

Table 2: List Of Simulation Papameters

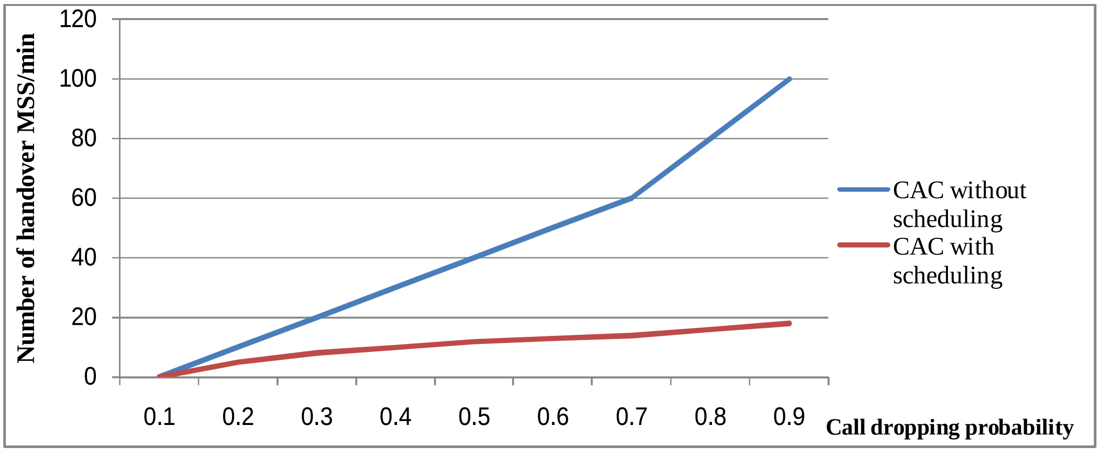

Figure 2: Number of Handover MSSs with dropping probability

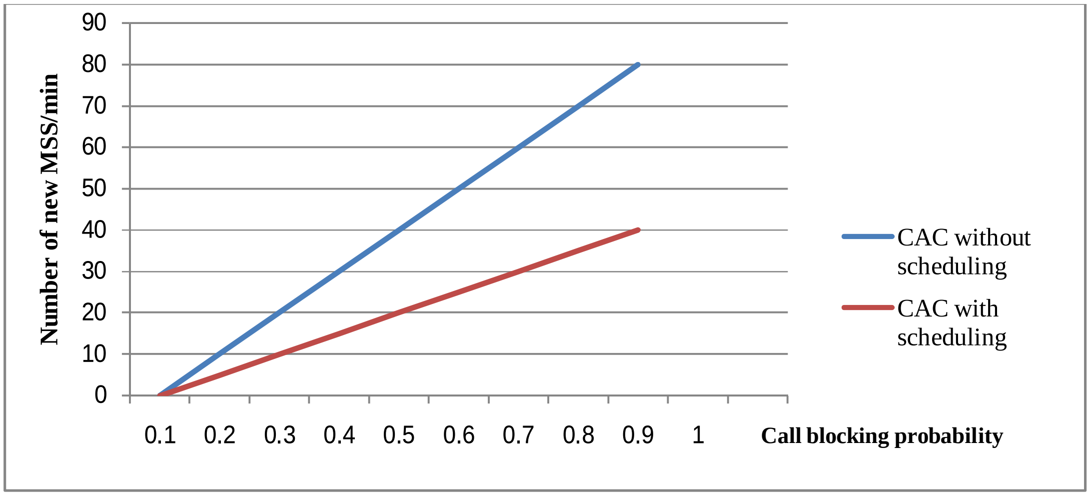

Figure 3: Number of new MSSs with blocking probability

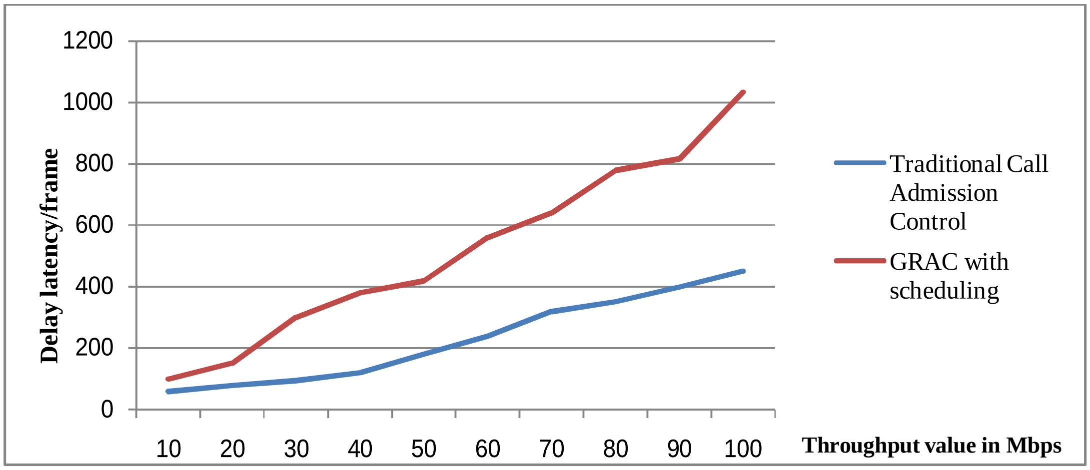

Figure 4: Comparison of throughput with CAC and scheduling algorithm

5. Conclusion

We have proposed Gateway Relocation Call Admission Control (GRAC) and Priority-based Scheduling Algorithm for uplink and downlink communication in an IEEE 802.16e Mobile WiMAX broadband wireless network. Our GRAC combines traditional Admission Control and ASN Gateway relocation and accept or reject a flow based on the predefined parameter called flow specifications. It also supports mobility management. . In our proposed Priority based scheduling algorithm differentiates the mobile stations with good channel conditions from poor channel conditions, and also differentiates the real-time traffics with the non-real-time traffics. Our simulation results shows call blocking and dropping probability of the system will be reduced and it also reduces delay, handover latency of network. As a result the Quality of Service is improved in terms of throughput and efficiency.

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