International Journal of Engineering and Advanced Technology (IJEAT)
ISSN: 2249-8958 (Online), Volume-2 Issue-2, December 2012

# Improved QoS for Fixed WiMAX Network

**M.Sathya, K.Kalaiarasi**

***Abstract— Applications such as video and audio streaming, online gaming, video conferencing, Voice over IP (VoIP) and File Transfer Protocol (FTP) demand a wide range of QOS requirements such as bandwidth and delay. IEEE 802.16 standard called WIMAX provides broadband wireless access with QOS requirements. The proposed work consists of a new uplink scheduling and Call Admission Control (CAC) algorithm for preferential treatment of service flows depending on QOS requirements. Using this scheduling and Call Admission Control algorithm fairness enhancement, with more connection acceptance***

***Index Terms— Call Admission Control (CAC), File Transfer Protocol (FTP) , scheduling, Voice over IP (VoIP) .***

## I. INTRODUCTION

WIMAX(Worldwide Interoperability for Microwave Access) is a new network
architecture providing high data rate wireless transmission. With the invention of WiMAX, the last mile broadband wireless can be achieved. The previous wire line based system established between users and ISP base stations can be replaced with microwave access deployment.

WiMAX in IEEE standard is defined as IEEE 802.16,which is also named as broadband wireless access (BWA).Two kinds of topology are currently supported, the PMP(Point-to- multipoint) topology and the mesh topology. It is just like the difference between infrastructure mode and Ad hoc mode in WLAN. In IEEE 802.16 the transmission range can be up to 30 miles, transmission rate up to 130 Mbps. It can do a great help to network users especially when they are in outdoors. The standard defines different evolutions line of sight (LOS) transmission using 10–66 GHz radio frequency and non-line of sight (NLOS) services at a frequency range between 2 and 11 GHz. WiMAX standard specifies two layers to name PHY and MAC. The PHY and MAC layer contribute in achieving QoS provisioning in a WiMAX network. Time division duplexing (TDD), frequency division duplexing (FDD) and orthogonal frequency division multiplexing (OFDM) are the standardized technologies for QOS provisioning at the PHY layer. TDD scheme is involved in QoS provisioning by separating the downlink and uplink bandwidth.

**Manuscript published on 30 December 2012.**
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## II. SERVICE FLOW

WIMAX consists of four different services as follows

1. **Unsolicited Grant Service (UGS):** UGS is meant to support real time data streams of constant bit rate services with fixed data packets are generated with periodic basis such as Voice over IP (VoIP) without silence. There are no such contention and piggyback.The request allowed in this service flow, and the BS does not provide a unicast request opportunities
2. **Real-time Polling Service (rtPS):** unlike UGS, rtPS support real time data stream of variable size data packets with a periodic basis such as Moving Picture Experts Group (MPEG) video and VOIP with silence suppression. Similar to the UGS, the contention and piggyback requests are prohibited for transmission and consists of nominal polling interval, tolerated poll jitter and minimum reserved traffic rate.
3. **Non-real-time Polling Service (nrtPS):** is defined for non-real time applications and generates variable size data grant with a regular with a minimum data rate. File transfer protocol (FTP) is one of the examples supported by nrtPS. Piggyback request. Nominal polling interval along with minimum reserved traffic rate and traffic priority is the key parameter for this service flow.[7]
4. **Best Effort (BE)**: there are no specific requirements and quality constrains defined in this service flow.

## III. CUSTOMIZED DEFICIT ROUND ROBIN SCHEDULER (CDRR)

An enhancement of Modified deficit round robiin with Strict Priority algorithm [1] leads to proposed of CDRR mechanism which reduces delay and improves the management of handling different services.

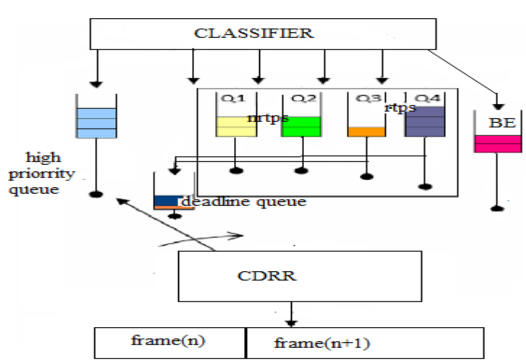


Figure 1


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In this scheme single queue is allotted for UGS and list of queues for both rtPS and nrtps carrying single request per queue. The algorithms such as FIFO for UGS, EDF with DRR for rtPS and DRR for nrtPS is proposed for serving various connections of services. In this scheme, an extra queue has been introduced to store a set of deadline requests. Unicast polling is continued for serving requests. Every time when the scheduler starts the scheduling cycle, extra queue is first checked. If the extra queue is not empty, the scheduler will serve this queue after the UGS using EDF. Once the extra queue becomes empty and there are available BW in the UL_MAP, the scheduler will continuing serving other rtPS and nrtPS queues by DRR . . It is assumed that when the connection get polling opportunity, more requests are expected to be sent in the next uplink frame.

## IV. QUADRA THRESHOLD CALL ADMISSION CONTROL

In our threshold-based bandwidth sharing scheme, each connection type is assigned a bandwidth threshold value according to a priority given to each connection type. The order of threshold priority is given as: UGS > ertPS > rtPS > nrtPS. BE connections are not considered. In 802.16 MAC layer, the BE connections get the transmission opportunities only when other service connections do not transmit. Generally, BE connections do have long idle period and data in each transmission is relatively small, especially in the uplink direction. Therefore QoS of BE can be easily satisfied Let T denote the set of threshold values for connection types. $T=\{t_n\ t_r\ t_e\ t_u\}$:

$$t_n \le t_e \le t_r \le t_u \le B \qquad (1)$$

where the parameters, $t_n$ , $t_r$, $t_e$ , $t_u$ denote the threshold values for UGS, ertPS, rtPS, nrtPS connections and parameter B, the uplink bandwidth capacity of the network respectively. The parameter B is dynamically adjusted by BS according to the uplink bandwidth requirement of connections after a period of time, T which is long enough for BS to understand the behavior of uplink bandwidth requirement. IEEE 802.16 defines a dynamic frame format of uplink and downlink subframe . UGS connections until the threshold point $t_r$ after which all rtPS connections are blocked

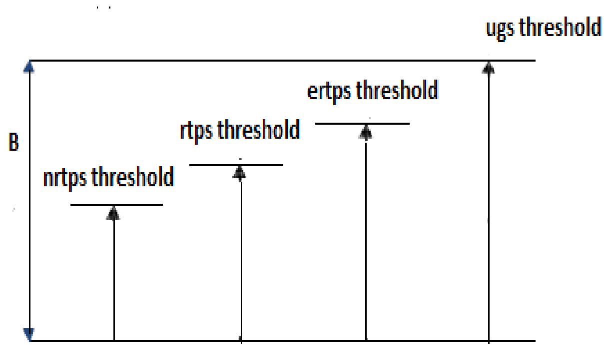


Figure 2

Figure 2 illustrates the QT CAC scheme; all connection types are admitted into the network provided that network resources are available to sustain the flows.When the network reaches threshold value $t_n$ all nrtPS connections are blocked and onlythe connections rtPS, ertPS and UGS connections are admitted. Similarly at threshold point $t_r$ all rtPS connections are blocked. The network now admits ertPS and UGS connections until $t_e$ threshold point. After that ertPS connections are now blocked and only UGS connection connections are admitted until $t_u$ , When a new high priority UGS connection arrives and if bandwidth.is not enough for ongoing connection to accept, decrease the departure rate of non real time polling service step by step the new request . If the degradation reaches to maximum amount and there is sufficient bandwidth accept it else reject the connection. Quadra-Threshold scheme QoS is guaranteed for each service type. The QT scheme does not only give priority to each connection type by assigning different thresholds but also ensures fairness to the connection types. [8]

The threshold value of each connection will be calculated by using the equations below:

$$t_u=\alpha_u B \qquad (2)$$
$$t_e=\alpha_e B \qquad (3)$$
$$t_r=\alpha_r B \qquad (4)$$
$$t_n=\alpha_n B \qquad (5)$$

where the parameters $\alpha_u$, , $\alpha_e$ ,$\alpha_r$, and $\alpha_n$ denote the threshold setting parameter of UGS, ertPS, rtPS and nrtPS connections respectively.

## V. STIMULATION RESULTS

The primary focus is to improve the quality of service by rejecting less connections during admission. Several modifications have been added to the WiMAX model in order to implement the proposed uplink scheduler and call admission control.The simulations are programmed on the Matlab platform, using some the analytical result. Simulation shows effect on network productivity in terms of acceptance ratio, bandwidth usage. Fig 1 shows the fairness ratio of existing and proposed scheduling algorithm with increase in the traffic. Fairness=$[T_{rtps}/S_{rtps}]-[T_{nrtps}/S_{nrtps}]$ where Trtps, Tnrtps and parameters represent the throughputs which were allocated to rtPS, nrtPS flow services, respectively, and Srtps, Srtps parameters denote the total traffic of rtPS, nrtPS services, respectively.

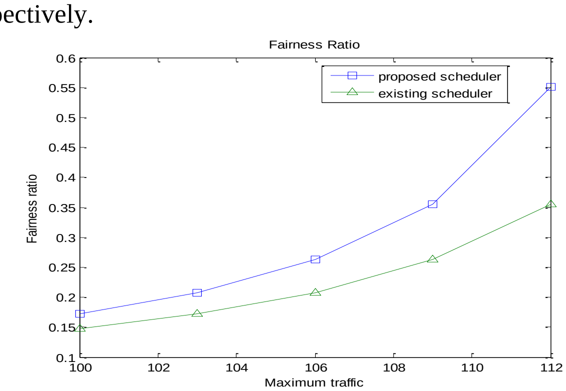


**Figure 1**


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International Journal of Engineering and Advanced Technology (IJEAT)
ISSN: 2249-8958 (Online), Volume-2 Issue-2, December 2012

Result show the throughput for rtPS connection for MDRR is lower than CDRR, due to consideration of deadline request

Figure 2 shows the bandwidth utilization ratio of existing and proposed call admission control algorithms with increase in the arrival rate

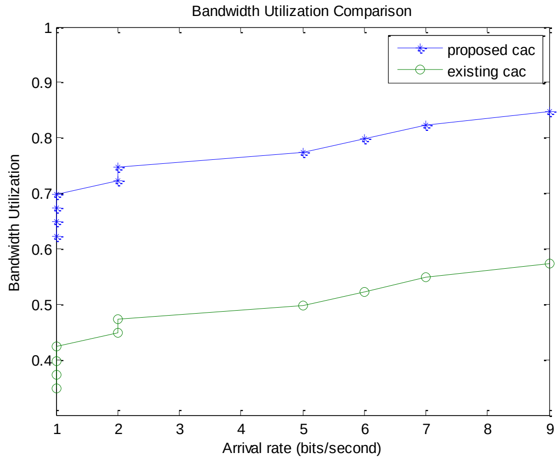


**Figure 2**

Figure 3 shows the blocking probability of RTPS class considering existing and proposed call admission control algorithms with increase in the arrival rate

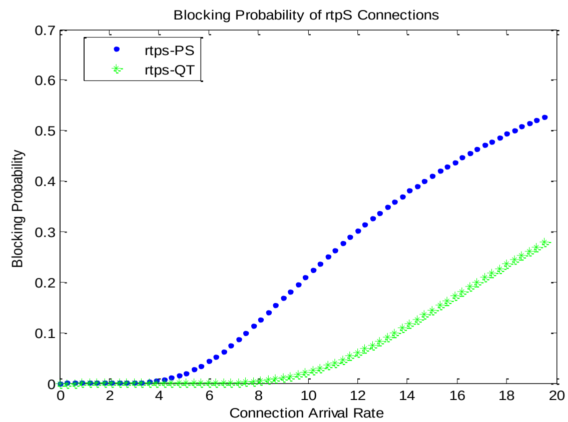


**Figure 3**

The existing CAC is does not able to provide delay guarantees .It accepts new connection of flows until there is enough capacity in the link. On the contrary, proposed CAC allows guaranteeing delay and checks the delay for all ongoing connection. Further if all connections soliciting for admission are rtPS connections, 86% of the total bandwidth units are used by that type of connection alone. Thus connection acceptance will be more in proposed model than the existing model as it use only the partitioned set of bandwidth which will be less than 86% total bandwidth . Therefore, with increase in connection arrival rate, the blocking probability of rtPS-PS increases from 0 after 4th connection arrival rate . In rtPS-QT scheme all ertPS connections are admitted until after 8th arrival rate when the blocking probability increases

Figure 4 shows the blocking probability of UGS class considering existing and proposed call admission control algorithms against the arrival rate . The Blocking probability of UGS PS increases linearly from 0 after the 4th arrival rate to the value of 0.51 after 18th arrival. The UGS-QT maintains almost zero blocking probability until after 10th arrival rate and increases gradually to 0.15 after 18th arrival rate. UGS-QT scheme achieve lower blocking probability as a result of sufficient uplink bandwidth available to its connections through the UGS threshold setting parameters. When other connections types do not solicit for bandwidth usage, the UGS connections make use of the total uplink bandwidth capacity. For UGS-PS, the connections only make use of the bandwidth within the set partition and the unused bandwidth of other connection types cannot be accessed by the UGS-PS connections.

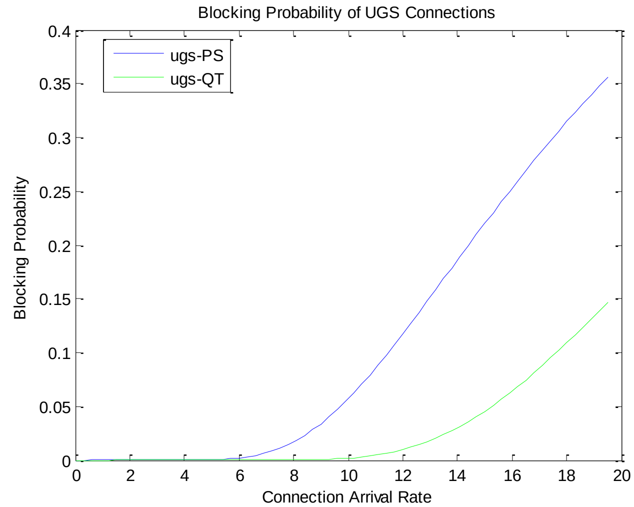


**Figure 4**

Figure 5 shows the blocking probability of ertPS class considering existing and proposed call admission control algorithms with increase in the arrival rate

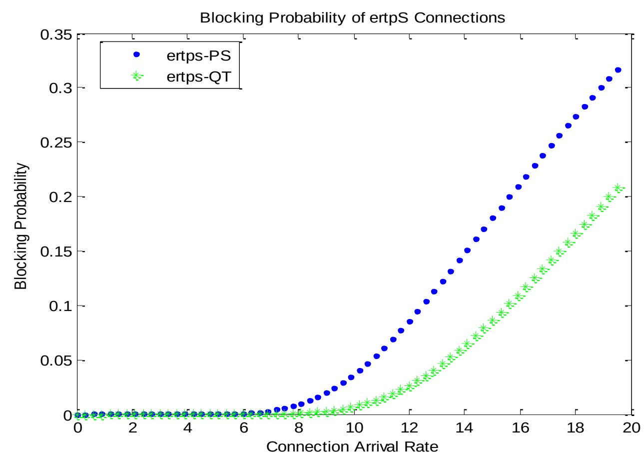


**Figure 5**

The proposed ertPS-QT scheme, shows more connections acceptance with less call blocking than existing model. This is because ertPS connections are admitted until the threshold value of 88 after which ertPS connection are rejected .Here delay for ongoing connection are checked for accepting the connection. This prevents congestion in the network.



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Figure 6 shows the blocking probability of NRTPS class considering existing and proposed call admission control algorithms with increase in the arrival rate

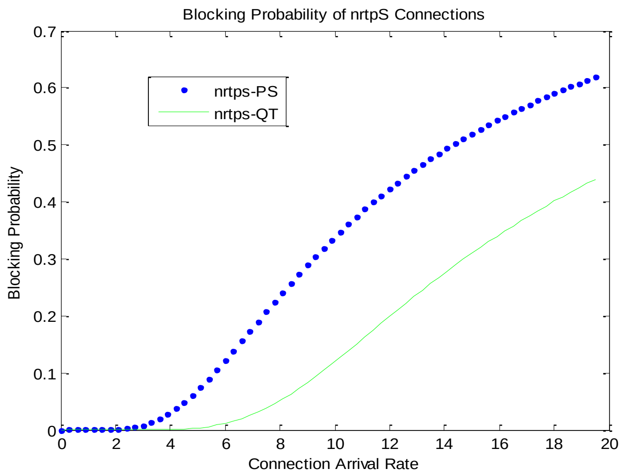


**Figure 6**

The nrtPS-PS connections suffer the highest blocking probability when compared to other connection types in the same scheme despite the high bandwidth value allocated to its partition. With proposed nrtPS-QT scheme, connections of nrtPS are admitted until the threshold value of 80 after when all nrtPS connections are rejected and if all the connections present are nrtPS connections 80% of the total uplink bandwidth are used. The blocking probability of nrtPS of PS schme high compared the QT scheme.

## VI. CONCLUSION

Here framework have focused on the dependencies and the relationships between the Scheduler and CAC in 802.16 networks. The presented scheduling algorithm increases fairness ratio and reduced delay. To successfully deploy a WiMAX system, we have to take into account the expectations of both service providers and subscribers. The proposed CAC module changes the grants boundaries of the connections QOS requirements to ensure efficient and fair use of the bandwidth resource. It is clear that multimedia applications require different QOS using one uplink channel for bandwidth request and one downlink channel for bandwidth granted by the base station

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