NEW BANDWIDTH ALLOCATION IN WIMAX SCHEDULING ALGORITHM FOR IMPROVING THROUGHPUT AND DELAY

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Abstract

Internet technology has rapidly changed in the last decade. It provides the quality in the ease of access and improved cost effectiveness, which makes it communication network of the day. The vast use of the internet is because of excessive services provided by it like checking sent emails, video applications, online tickets and chatting etc. which is increasing day by day. But, there are some technical challenges need to be resolved. IEEE802.16 standard provide the future worldwide deployment of Broadband Wireless. It is capable of enabling millions of nodes to use wireless Internet, at cheaper cost & ease. WiMAX wireless coverage will be measured in square kilo meters whereas Wi-Fi is measured only in square meters. Wi-Fi had the lack of providing network guarantees like error rate, delay in packets and throughput. These guarantees are accounted during effective real time transmission of Voice over IP and video conferencing using internet. In this paper we emphasize on a MAC scheduling algorithms of WiMAX & its implementation steps in ns-2 for IEEE 802.16 standards.

Keywords- *Wireless Networks, GSM, CDMA, QoS, MAC, and Media Access Control.*

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1. INTRODUCTION

WiMAX is referred to as a protocol providing fixed and mobile access to the internet [1]. WiMAX forum formed in 2001 has decided the name. This forum is responsible to promote conformity and interoperability over large heterogeneous networks combining several local area networks according to certain accepted standards [2]. Original focus of the WiMAX was on fixed radio access and based on IEEE standard 802.16-2004 specification. It is being modified since the original implementation. Another type has emerged known as mobile WiMAX as described in IEEE 802.16e-2005 standards which focus on mobile access over broadband networks [3].

The differences between the two types of WiMAX networks is that, fixed WiMAX deploys an uni-directional antenna at user's end with High gain-low portability and low portability provides a limited broadband access. Whereas mobile WiMAX provides because at user end deploys low gain and high portability omni directional antenna embedded in flash drive sized modem [3].

WiMAX network implementation requires similar telecommunication infrastructure to that of voice communication networks (GSM, CDMA). About 592 WiMAX (fixed and mobile) networks have been deployed in 148 countries [4].

The paper contents are Section II details are related to the problem statement definition. In Section III there is a review of literature. Sections IV provide the design of WiMAX system & simulation framework and in section V discuss their discussion on observations, findings and conclusion.

2. PROBLEM STATEMENT DEFINITION

The data transfer between the uplink subscriber station to base station (SS-BS) and base station to service station (BS-SS) directions is carried out with the help of time division multiple access (TDMA) in media access protocol. The time is divided in to frames separated by time intervals. Each frame is divided between uplinks Sub Frame and downlink Sub Frame.

The downlink Sub Frame contains two fields for managing allocation of wireless communication.

DL—MAP: - The downlink bandwidth allocation map to tell the SS of the time table and physical layer transmission packets bursts.

UL—MAP:- The Uplink bandwidth allocation map. It controls the amount of time each SS is given access to the channel in the next uplink sub frames [5].

In the above mentioned wireless communication, there is a requirement of allocating slots to each SS to fulfill each client's requirements. In order to better support quality of services (QoS) requirement of clients, the standards defines key parameters like minimum delay & high throughput [6].

WiMAX is referring to attain QoS in terms of throughput, achieving the same in mesh WiMAX is challenging.

IEEE802.16 Media Access Control (MAC) to resolve problems generated traffic by multimedia applications or streaming video from transmission of the neighboring WiMAX node in India. (*i. e*. villages)[7].

3. REVIEW OF LITERATURE

Currently WiMAX networks are mostly deployed in metropolitan areas, it is therefore in our interests to validate that the new technology works even in the most rural environments [8].

Another source of motivation is based on the main objectives of this research is use ICT for development in rural and marginalized areas. Deploying /merging the fixed WiMAX network in rural areas into a mobile WiMAX network will not only help to increase the internet coverage area provided by the WiMAX /WiFi hot spots but it will increase accessibility and mobility to the already provided to the community also will furnish an opportunity for growth in e-services that could be rendered in the future, provided that the network will be sustained.

In [6], other hand WiMAX is based on IEEE802 .16 standards provides broadband wireless access to mobile broadband connection. Five types quality of service flow defined by the IEEE 802.16e standard.

In [7], present a history of packet delays to classify packets in four classes & scheduler provides higher priority to packet to user end those channel condition is best. Study on UGS and rtps had been presented.

The authors [9], have highlighted a problem of Real-Time (rtps & UGS) services class and provide a appropriate solution for real time service class. The authors proposed problem was to a cross layer structure algorithm NS-3 Simulation were used and provided results are interesting and enhance throughput and decrease delay.

In [10], authors have provided detailed survey about different scheduling algorithms for PMP WiMAX mode, as well as provide details about WiMAX service classes their applications and some performance evaluation parameters.

In [11], author has evaluated different type of scheduling algorithms of wireless networks like Round Robin, Strict Priority, Weighted Fair Queuing and Weighted Round Robin etc., brief introduction of WiMAX and QoS service classes was also given.

In [12], authors have given a comparative analysis of two different scheduling algorithms, Weighted Fair Queue (WFQ) and Priority Queue (PQ). Different issues like end to end delay and packet reception and transmission details are used to evaluate the algorithms.

In [13], author's had focus on QoS analysis in WiMAX networks. It also included information about different service flows and their uses defined by IEEE802.16 Standards.

The [14], authors have presented based on fully centralized scheduling scheme for allocation resources. In this approach FIFO and WFQ scheduling classes are used.

In [15], authors have proposed two level scheduling schemes called TLS that have supported for fairness and quality of service for downlink traffic in WiMAX network. At first stage, High Priority packets classified according to their QoS classes by the scheduler. UGS have the highest priority and BE have the lowest priority whereas, ertPS, rtPS and nrtPS lies between them. Each classified QoS class has separate queues for packets and packets are placed into various priority queues according to their priority. Whereas, at second level, authors have used fairness scheduling for various service classes. Fairness approach that used for ertps and rtps is Adaptive proportional Fairness used for nrtPS and BE services whereas, UGS required fixed data rates due to this BS forward fixed data size packets at periodic intervals.

In [16] [17], authors have used FIFO, PQ and WFQ scheduling algorithms to schedule data traffic according to the QoS classes defined by the standard. Authors confirmed the performance of these algorithms by considering different QoS analysis parameters like Delay, Load and Throughput.
In [18], authors have considered Queuing Delay and Buffer utilization to evaluate performance in WiMAX.

4. DESIGN OF THE WIMAX SYSTEM

As scheduling algorithms perform critical role in band-width sharing and packet scheduling process, every algorithm should have some purpose or aim, on the basis of which it is used. First of all, used algorithm should have capability to share total amount of bandwidth in fair manner. Secondly, every SS in network should have minimum guaranteed bandwidth. Thirdly, should have capability to reduce variations in latency. All these purposes are helpful in provision of QoS.

A. Proposed Operational scheduling Algorithm

The Figure 4.2 shows that, the allocated bandwidth is granting a request, the system has to check QoS Polling services, nominal polling jitter and reference time i.e. to calculate the generation time and the target of the rtps data. This information is gathered from this scheme is used to calculate approximate the expected delay of each rtps connection and this algorithm is also used to calculate target throughput and delay.

IEEE802.16 has two modes for allocation bandwidth requested by Subscriber Station:
Grant per connection (GPC): The bandwidth is allocated as per connection of SS. SS had no scheduler for the packets forwarding to the BS.

Grant per Scriber Station (GPSS): Bandwidth is allocated to all SS & their connections.

B. System Development Methodology *Implementation*

This architecture is designed to fulfill the listed objectives:

- Packets are scheduled in Uplink direction as per their priority, UGS packets having highest priority and after that nrtps and rtps packests.
- The packet is sent one after another in the downlink direction in SS based on the set priority of the packet.

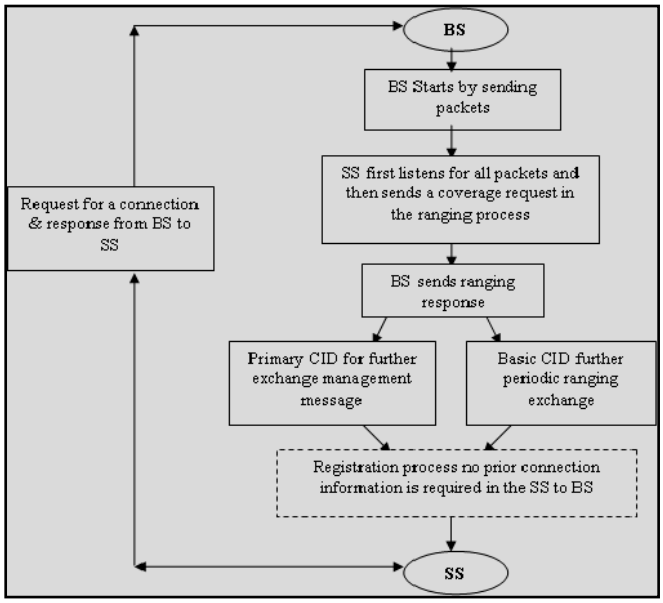

Figure 4.1: Flowchart for Network initialization.

- The UGS packets are sent first as per FIFO and same type of rtPS and nrtPS packets are sent as per FIFO.

C. Implementation Steps of Wimax

The drawback of any wireless communication structure is that coverage ranging area data rates are imperfect. To overcome this limitation in WiMAX communication structure the coverage ranging area is increase by changing the bandwidth. The following steps are involved in ns2 for implementing WiMAX point-to-multipoint communication [20][21].

Step 1: In figure 4.2 we have used the ns-2 version 2.34 for implementing WiMAX point-to-multipoint communication wa1.tcl.

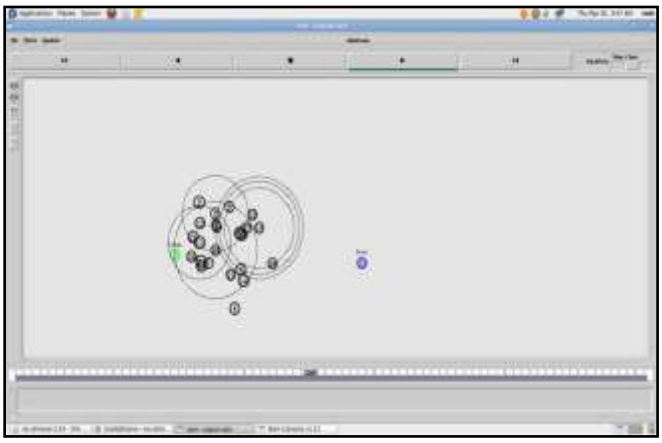

Figure 4.2: simulation Setup

Step 2: make changes in mac_802.16.cc, mac-802_16.h and ll.c, packet.h
Step 3: Add the given parameters in the files mac-802_16.cc, mac-802_16.h
Step 4: For this implementation purpose we have used linux (Fedora 12 version).
Step 5: After execution of the wa1.tcl file, the trace file is generated wa1.tr, it includes the information about packets sending & receiving time, packets drop & transfer from BS to SS in figure 4.3.

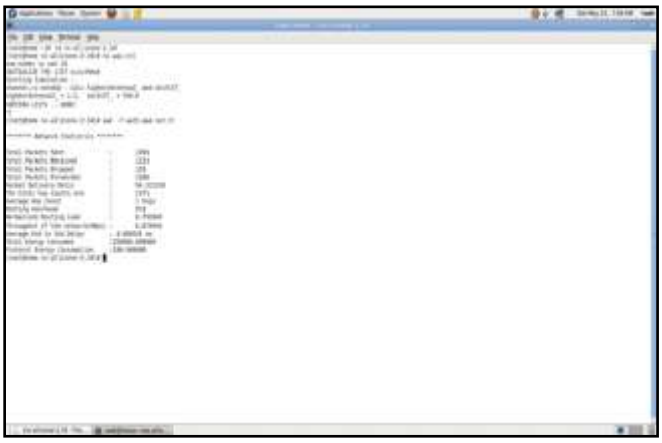

Figure 4.3: Trace File

Step 6: For displaying the graph the Microsoft Excel 2007 can be used. Even though we can use the xgraph, gnuplot command in ns-2 & MatLab for graph plotting purpose [22].

CONCLUSION

In this paper we emphasized on MAC Scheduling architecture for IEEE802.16 standards. The MAC scheduling architecture uses the downlink and the uplink scheduling scheme for improving throughput and delay.

WiMAX P-M-P module was implemented by using ns-2 tool and C++ programming language and flowchart for network initialization is proposed.

Thus, the proposed algorithm can be validated to capable of enhancing the performance of WiMAX network to check quality of services classes requirements.

Best Effort quality of services class is used in normal condition to get Maximum Throughput for villages in India as e-services and in all secondary school for ICT purpose.

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REFERENCES

[1]. Frank Chee-Da Tsai, Jenhui Cheny, Chiang-Wei Chang, Wei-Jen Lien, Chih-Hsin Hung, and Jui-Hsiang Sum, “The Design and Implementation of WiMAX Module for ns-2 Simulator” , Conference on mobile multimedia communication, September 2007, Vol 46, pp 1024-1039.

[2]. Borin, J.F. and N.LS.D. Fonseca,”Uplink scheduler and admission control for the IEEE 802.16 standard”. Proceedings of the IEEE Global Telecommunications Conference, Nov. 30-Dec. 2009, IEEE Xplore Press, Globecom, DOI: 10.1109/GLOCOM.2009.5425779, pp: 1-6..

[3]. Mardini, W., Y. Khamayseh, M.B. Yasin and G. Obiedat, 2011. “Survey of latest WiMAX technologies and technique”. Int. Rev. Comput. Softw.

[4]. Goyal, P. and A. Sahoo,”A scheduling and call admission control algorithm for WiMax mesh network with strict QoS guarantee”. Proceedings of the 2nd International Conference on Communication Systems and Networks, 2010 Jan. 5-9, IEEE Xplore Press, Bangalore, DOI: 10.1109/COMSNETS.2010.5431997, pp: 1-10.

[5]. Ahmet Sekercioglu,Y.20090918.” A survey of MAC based QoS imlementation for WiMAX networks”. Computer Networks.

[6]. Hsiao, Y.M., J.F. Lee, J.S. Chena and Y.S. Chu, 2011.” H.264 video transmissions over wireless networks: Challenges and solutions”. Comput. Commun., 34: 1661-1672. DOI: 10.1016/j.comcom.2011.03.016.

[7]. Ghazizzadeh, R., P. Fan and Y. Pan, 2009. “A two layer channel aware scheduling algorithm for IEEE 802.16 broadband wireless access systems”. J. Applied Sci., 9: 449-458. DOI: 10.1109/MNET.2009.4305171.

[8]. TCS, 2009. “WiMAX base station scheduling algorithms”. Tata Consultancy Services.

[9]. M.Vijayalakshmi,Swaroop R.Puranik, et al. " A Cross Layer Scheduling Algorithm in IEEE 802.16e WiMAX Standard to Support RTPS Traffic" CSNT’14 Proceeding of the 2014 Fourth International Conference on Communication Systems and Network Technologies (2014): 347-351.

[10]. Murawwat, Sadia, et al. "An Overview of Scheduling Strategies for PMP Mode in IEEE 802.16." Sci. Int. (Lahore) 24.3 (2012): 307-315.

[11]. Cicconetti, Claudio, et al. "Performance evaluation of the IEEE 802.16 MAC for QoS support." Mobile Computing, IEEE Transactions on 6.1 (2007): 26-38.

[12]. Singla, Saruchi, and Maninder Singh Kamboj. "Analysis of Packet Scheduling in WiMAX Network." International Conference on Recent Advances and Future Trends in Information Technology. 2012.

[13]. Lin, Jin, and Harshadirisena. "Quality of service scheduling in IEEE 802.16 broadband wireless networks." Industrial and Information Systems, First International Conference on. IEEE, 2006.

[14]. Wongthavarawat, Kitti, and Aura Ganz. "Packet scheduling for QoS support in IEEE 802.16 broadband wireless access systems." International Journal of Communication Systems 16.1 (2003): 81-96.

[15]. Nie, Wei, Houjun Wang, and Jong Hyuk Park. "Packet Scheduling with QoS and Fairness for Downlink Traffic in WiMAX Networks." JIPS 7.2 (2011) pp:261-270.

[16]. Kumar, A., Garg, D. "Queuing Algorithm Based Quality of Service (QoS) For Scheduling Environment Model in WiMAX Network with Opnet Modeler." Global Journal of Researches in Engineering, 11.8 (2011) pp: 35-40.

[17]. Chou, Li-Der, Yen-Cheng Lin, and Zi-Hong Chen. "QoS coordinated distributed scheduling for 802.16 mesh networks." Internet, 2009. AH-ICI 2009. First Asian Himalayas International Conference on. IEEE, 2009.

[18]. A.Rehan, Mustafa Shakir. "Comparative Analysis of Scheduling Algorithms in IEEE 802.16 WiMAX." Internet, 2014. “International Journal of Computing and Digital Systems”. Scientific Publishing Center, University of Bahrain,pp:: 161-172.

[19]. Min Xing, Student Member, IEEE, Siyuan Xiang, Member, IEEE, and Lin Cai, Senior Member, IEEE“A Real-Time Adaptive Algorithm for Media and video streaming over Multiple Wireless Access Networks” VOL. 32, NO. 4, APRIL 2014.

[20]. Angana Chakraborty, Sajal Saha, Indrajit Banerjee and Arnab Gupta “Optimized WiMAX Network Development in India: Specification and Implementation” Springer India 2015 Computational Advancement in Communication Circuits and Systems, Lecture Notes in Electrical Engineering pp: 89-99., DOI 10.1007/978-81-322-2274-3_11.

[21]. Xiaoliang (David) Wei. Amini “TCP-Linux in ns-2”, tutorial available at http://netlab.caltech.edu/projects/ns2tcplinux/.

[22]. The ns2 network simulator: available at http://www.isi.edu/nsnam/ns/.ns2.html.

[23]. Yahya Abdullah Yahya Al zahrani “Performance Analysis of the Impact of the Propagation Environments on the WiMAX Service Classes” International Journal of Future Generation Communication and Networking Vol. 8, No. 1 (2015), pp:117-126.

[24]. A.S.Kaspe” Wimax: A implementation and study its effect for new MAC scheduling algorithm for improving throughput & delay”, 2011 IEEE International Conference on Computational Intelligence and Computing Research, 978-1-61284-693-4/11/$26.00,pp:135-138.