

Hybrid Scheduling Algorithm For Performance Boost In Wimax

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ABSTRACT

Worldwide Interoperability for Microwave Access (Wi-MAX) networks were expected to be the main Broadband Wireless Access(BWA) technology that provided several services such as data, voice, and video services including different classes of Quality of Services (QoS), which in turn were defined by IEEE 802.16 standard. Deficit Round Robin (DRR) is a fair packet-based scheduling discipline commonly used in wired networks where link capacities do not change with time. In wireless networks especially wireless broadband networks such as IEEE 802.16e Mobile WiMAX, the capacity can change over time and also depends on the user location. Moreover, WiMAX allows packet which violates the packet-based service concept of DRR. Therefore, the traditional DRR can't directly be used in such networks. Therefore, we introduce Priority based Deficit Round Robin (PBDRRF) to allocate resources in a fair manner, while allowing for varying link capacity. In addition, we extend PBDRR to support users with minimum reserved traffic rate, minimum delay and traffic priority.

Index Terms—Deficit Round Robin, priority, WiMAX, IEEE 802.16e, Scheduling, Fairness, QoS

1. INTRODUCTION

WiMAX (Worldwide interoperability for Microwave Access) is the most emerging technologies for Broadband Wireless Access (BWA). WiMAX can be used for a number of applications, including “last mile” broadband connections, hotspots and high-speed connectivity for business customers. Furthermore, WiMAX not only enhances the existing features of the competitive cabled access networks, but provides high data rate applications with a variety of Quality of Service (QoS) requirements.

The Institute of Electrical and Electronics Engineers (IEEE) 802 committee, which defines networking standards such as Ethernet (802.3) and Wi-Fi (802.11), has published some standards that

Define WiMAX. IEEE 802.16-2004 (also known as Revision D) was published in 2004 for fixed applications; 802.16 Revision E (which adds mobility) is published in July 2005. The WiMAX Forum is formed to promote the IEEE 802.16 standard and perform interoperability testing. The WiMAX Forum has accepted some profiles based On the 802.16 standards for interoperability testing and “WiMAX certification”.

We are discussing the goal of realizing a unique wireless network to cover a big area. In a large scale wireless network, the radio resource must be shared among multiple users.

2. WiMAX ARCHITECTURE

WiMAX based on the standard IEEE 802.16, which consist of one Base Station (BS) and one or more Subscriber Stations (SSs), as shown in Figure 2.1, the BS is responsible for data transmission from SSs through two operational modes: Mesh and Point-to-multipoint (PMP), this transmission can be done through two independent channels: the Downlink Channel (from BS to SS) which is used only by the BS, and the Uplink Channel (from SS to BS) which is shared between all SSs.

2.1 WiMAX Operation Modes

PMP Mode

FDD scheme and TDD scheme is used in this operational mode. The signal traffic occurred only between the BS and SS. The signal direction from BS to SS is called downlink and the opposite like direction called uplink. In the FDD scheme, both the uplink and downlink signal transmission occurred simultaneously and in the TDD scheme, transmission time divided into uplink and downlink periods.

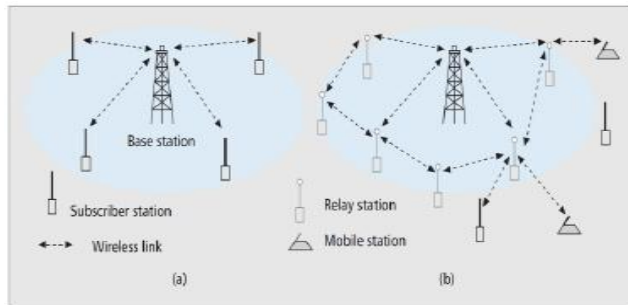


Fig.2.1- WiMAX network architectures: (a) PMP mode; (b) mesh mode

Mesh Mode

The IEEE Std 802.16a-2003 introduced to allow the WiMAX nodes to establish mesh networks. [6] Defines “Mesh” as “network architecture, wherein systems are capable of forwarding traffic from and to multiple other systems”. If every node in a network directly connects to every other node, it is called a “fully meshed network”. Otherwise, it is a “partial meshed network”. In partial Mesh Network, every node is not connected to each other. On the other hand, in full mesh network, every nodes are connected each other so that if a node is disconnected anyway or unable to forward signal to another node then it can chose alternative node.

2.2 WiMAX Components

WiMAX contains the following four components to describe architecture of WiMAX network. They are:

Base Station-A Base station basically describe a wireless access point .it communicate with devices or subscribers based on Wi-Fi standards. It is also works on a Master-relay base station in multiple relay topologies.

Subscriber Station-Subscriber station refers to a generalized equipment set that provides connectivity between the subscriber equipment and the base station within the mobile wireless network that user subscriber is using.

Mobile subscriber- Mobile Subscriber is nothing but a wireless node that runs along with the vehicular speed. For example cellular phones, laptops and other portable devices.

Relay Subscriber-Basically Relay Stations are subscribers stations configured for traffic forwarding to other station like relay station,

subscriber station or mobile station in a multi-hop security zone.

3 IEEE 802.16 Service Classes

The IEEE 802.16-2004 standard [10] specifies the provision of four scheduling services:

Unsolicited Grant Service (UGS): This scheduling service is designed to support applications that generate fixed-size data packets periodically such as T1/E1 and VoIP without silence suppression. To support the real-time needs of such applications and reduce overhead by the bandwidth request-grant process, the BS allocates fixed size data grants without receiving explicit requests from the SS. The size of the grants is based on the maximum rate that can be sustained by the application and is negotiated at connection setup.

Real-time Polling Service (rtPS): This scheduling service is designed to support real-time applications that generate variable size packets on a periodic basis such as MPEG video or VoIP with silence suppression. The BS allows the SSs to make periodic unicast requests and allows them to specify the size of the desired grant. This class is prohibited from using contention request opportunities.

Non real-time Polling Service (nrtPS): nrtPS is designed to support non-real time applications that require variable size data grant bursts on a regular basis. This scheduling service supports applications that are delay tolerant but may need high throughput such as File Transfer Protocol (FTP) applications. The BS allows the SS to make periodic unicast grant requests, just like the rtPS scheduling service, but the requests are issued at longer intervals.

Best Effort (BE): This traffic class contains applications such as telnet or World Wide Web (WWW) access that do not require any QoS guarantee. The bandwidth request by such applications is granted on space-available basis. The SS is allowed to use both contention-free and contention based bandwidth requests, although contention-free is not granted when the system load is high.

4 HYBRID SCHEDULING FOR WIMAX

4.1 Priority based Deficit Round Robin

In DRR, we use round-robin servicing with a quantum of service assigned to each queue, the only difference from traditional Deficit round robin is that if a queue was not able to send a packet in the previous round,, the remainder from the previous quantum is added to the quantum for next round. Then among packets higher priority packet

have chance to send packet first. Priority based Deficit round robin scheduling is the same as a normal round robin except that if a queue was not able to send a packet in the previous round because its packet size was too large, the remainder from the previous quantum M added to the quantum for the next round. Then higher priority packets have chance to send packet. Thus deficits are kept track off, queues that were short-changed in a round are compensated in the next round.

4.2 PBDRR scheduler retrieve packet.

// this function checks priority assignments before running PBDRR scheduling technique.

If (user not assigned priority):

// retrieve function call Auto priority assignment function.

// auto priority assignment assigns to each active queue weight.

Auto priority assignment

// calculate sum of all active queues (priority).

For (i=0; i < num queues; i++):

Sum Queue Priority += (Queue Data [i]. priority).

1. End if.

// gives priority to each active queue based on its priority.

2. Assign priority to each active queue.

3. For (i=1; i <= num queues; i++):

4. Queue Data [i] = (Queue Data [i]. priority) / sum Queue Priority.

// this function calculates the total priority counter value for PBWRR packet scheduler

8. Calculate PBWRR service Round.

9. For (i=0; i < num queues; i++):

10. Service Round += QueueInfo [i]. Priority Counter

5 SIMULATION AND RESULTS

The proposed SS-assisted scheduling algorithm was simulated under the Network Simulator NS-3.17 [19] using first a network topology consisting of 02 SS nodes interconnected through a single BS node. Then, the number of SSs was varied to test the scalability of the proposed approach.

The following parameters are used in scenario:

- Bottleneck-link-delay – 1 ms
- Bottleneck Bandwidth – 10 Mbps
- Transport protocol type – UDP/TCP
- routing protocol – DSDV
- Packet size of UDP/TCP – 1500 bytes
- Scheduler – PBDRR
- Simulation Duration - 100 sec
- Modulation – OFDM 64 QAM
- Coverage area of base station – 500 m radius
- Other parameters used in queue scheduling schemes are set to the default values

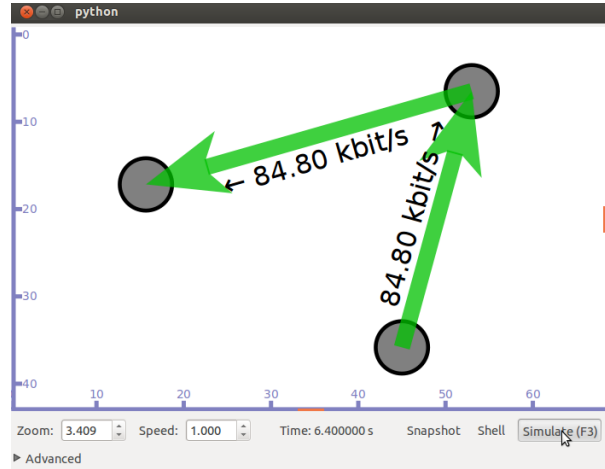


Fig 5.1 shows simulation of 3 nodes

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shaniu@shaniu-Inspiron-N4010:~/ns/ns-allinone-3.17/ns-3.17
shaniu@shaniu-Inspiron-N4010:~/ns/ns-allinone-3.17/ns-3.17$ ./waf --run scratch/RRscheduling
waf: Entering directory '/home/shaniu/ns/ns-allinone-3.17/ns-3.17/build'
waf: Leaving directory '/home/shaniu/ns/ns-allinone-3.17/ns-3.17/build'
'build' finished successfully (2.374s)
TraceDelay TX 1024 bytes to 10.1.1.1 Uid: 11718 Time: 6
TraceDelay: RX 1012 bytes from 10.1.1.2 Sequence Number: 0 Uid: 11718 TXtime: +600000000.0ns RXtime: +6016872017.0ns Delay: +16872017.0ns
TraceDelay TX 1024 bytes to 10.1.1.1 Uid: 12692 Time: 6.5
TraceDelay: RX 1012 bytes from 10.1.1.2 Sequence Number: 1 Uid: 12692 TXtime: +6500000000.0ns RXtime: +6522382040.0ns Delay: +22382040.0ns
shaniu@shaniu-Inspiron-N4010:~/ns/ns-allinone-3.17/ns-3.17$ ./waf --run scratch/RRscheduling
waf: Entering directory '/home/shaniu/ns/ns-allinone-3.17/ns-3.17/build'
waf: Leaving directory '/home/shaniu/ns/ns-allinone-3.17/ns-3.17/build'
'build' finished successfully (2.363s)
TraceDelay TX 1024 bytes to 10.1.1.1 Uid: 11718 Time: 6
TraceDelay: RX 1012 bytes from 10.1.1.2 Sequence Number: 0 Uid: 11718 TXtime: +6000000000.0ns RXtime: +6016872017.0ns Delay: +16872017.0ns
TraceDelay TX 1024 bytes to 10.1.1.1 Uid: 12692 Time: 6.5
TraceDelay: RX 1012 bytes from 10.1.1.2 Sequence Number: 1 Uid: 12692 TXtime: +6500000000.0ns RXtime: +6522382040.0ns Delay: +22382040.0ns
shaniu@shaniu-Inspiron-N4010:~/ns/ns-allinone-3.17/ns-3.17$
    
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Fig 5.2 shows Results using ns3

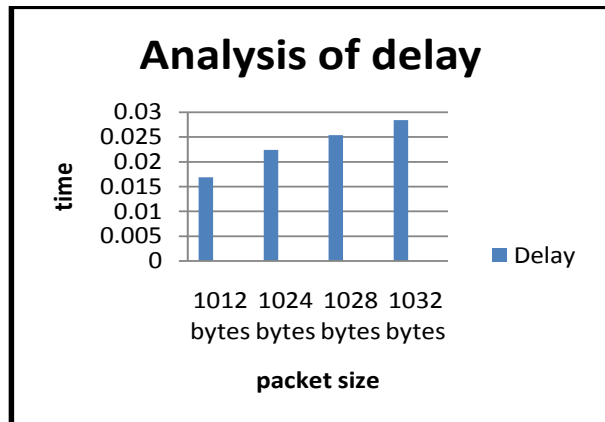


Fig 5.3 analysis of delay at various packet sizes

6 CONCLUSIONS

In this proposed method PBDRR algorithm is implemented using ns3. We analysis delay at various packet size .as results shows as packets size is longer delay is longer as less packet size. In future work develop algorithm for mobile WiMAX.

7 ACKNOWLEDGMENTS

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8 REFERENCES

- [1] Wail Mardini “Modified WRR Scheduling Algorithm for WiMAX Networks” Network Protocols and Algorithms ISSN 1943-3581 2011, Vol. 3, No. 2
- [2] A Performance Evaluation Study of WiMAX Using Qualnet. Shuaib, Khaled A. London U.K: Proceedings of the World Congress on Engineering 2009, 2009, Vol. I. WCE.
- [3] Wail Mardini, Yaser Khamayseh, Muneer Bani Yasin, and Ghadeer Obiedat. Survey of Latest WiMAX Technologies and Techniques. s.l.: Jordan University of Science and Technology, 2011.
- [4] Comparative Study of Scheduling Algorithms in WiMAX. Arhaif, Mohammed Sabri. 2, s.l. International Journal of Scientific & Engineering Research, 2011, Vol. 2. ISSN 2229-5518.
- [5] Comparative Study of Scheduling Algorithms for WiMAX. Ashish Jain, Anil K.Verma. Chennai, India: Proceedings of the National Conference on Mobile and Pervasive Computing, 2008. pp. 10-13.
- [6] Data throughput of CDMA-HDR a high efficiency-high data rate personal communication Wireless system. Jalali, A., Padovani, R. and Pankaj, R. Tokyo, Japan: Proc. IEEE VTC pp. 1854–1858, 2000.
- [7] H.Fattah and C.Leung, “An overview of scheduling algorithms in wireless multimedia networks,” IEEE Wireless Communication, vol.9, no.5, pp.76-83, Oct. 2002
- [8] H.Zhang, “Service Disciplines for Guaranteed Performance Service in Packet switching Networks,” Proceedings of the IEEE, vol. 83, pp. 1374-96, Oct. 1995,
- [9] R.Guerin and V.Peris, “Quality-of-service in Packet Networks: Basic Mechanisms and Directions,” Computer Networks, vol.31, pp.169-89, Feb. 1999.
- [10] Ala’a Z. Al-Howaide, Ahmad S. Doulat, Yaser M. Khamayseh “Performance Evaluation of Different scheduling Algorithms In WiMAX”.

- [11]Y.Cao and V.Li, “Scheduling Algorithms in Broadband Wireless Networks”, Proceedings of the IEEE, pp.787, January 2001.