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Research Article

Analysis of Channel Conditions Based on Transmission Rate of 802.16 Wimax Network

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Abstract

Broadband wireless communication in Metropolitan Area Networks is done through the IEEE 802.16 standard, also known as Wi-MAX. To achieve a good and efficient Quality of Service (QoS) in a Wi-MAX network, rate allocation is necessary. Rate allocation also provides fairness among the users. In this paper, we propose performance evaluation of Wi-MAX network based on transmission rate. By the simulation results, we deduce that the proposed scheme reduces the average delay and improves the average throughput. The Qualnet 6.1 Simulator was used to carry out the simulation.

Keywords: *IEEE 802.16 (WIMAX), QoS, Qualnet, Transmission Rate.*

1. Introduction

IEEE 802.16, also called worldwide interoperability for microwave access (Wi-MAX), is a standard for metropolitan area networks (MANs). IEEE 802.16 originally specifies the air interface, including the medium access control (MAC) layer and physical layer, of a fixed point-to-multipoint broadband wireless technology. It is well suited for point-to-multipoint data transmission with data rates up to 120 Mbps. In addition to fixed wireless accesses, it also specifies mobility functions to support mobile users. A Wi-MAX-based network has subscriber stations (SSs) and mobile subscriber stations (MSSs) communicate with base stations (BSs) via air interfaces.

In IEEE 802.16, BSs are responsible for allocating radio resources for SSs under its covering area. With the ability of broadband wireless access of IEEE 802.16 networks, a proper resource allocation scheme for packet transmissions is imperatively needed, which has a great influence on system performance and quality of service (QoS) provided by IEEE 802.16 networks. Several scheduling algorithms, such as adaptive uplink and downlink bandwidth adjustment, aim to achieve higher transmission performance. Even with these methods and algorithms, the packet queuing delay and radio link utilization of an IEEE 802.16-based network cannot be greatly improved due to its frame structure and bandwidth requesting/granting procedure. To deal with this problem and make the best use of precious resources in IEEE 802.16-based wireless environments, we propose a new resource allocation scheme.

The rate allotment problem in IEEE 802. 16 mobile is basically how to schedule resources for each users in each mobile Wi-MAX frame Wi MAX is OFDMA based and multiple narrowband beams can be generated easily. High data rate wireless communication with quality of service (QOS) comparable to wireless technology strong need of the modem society of information due to increasing demand of multimedia services for mobile users. Orthogonal Frequency Division Multiplexing (OFDM) wireless system performs better channel data transmission and detection. In IEEE 802.16 mobile the problem is to allot resources and rate for each user in the mobile Wi-MAX frame. Multiple narrowband beams can be very easily generated as Wi-MAX is OFDMA based.

2. IEEE 802.16 Medium Access Control

The IEEE 802.16 MAC standard resembles the IEEE 802.14 standard. According to the standard, the transmission direction of downlink (DL) is from Base Station (BS) to Subscriber Stations (SSs) and the direction is from Subscriber Stations (SSs) to Base Station (BS) for Uplink (UL). The two duplexing modes included in the standard are (1) Frequency division duplexing (FDD) (2) Time division duplexing (TDD).

Fig.2 (a), shows the basic structure of a downlink sub-frame. The sub-frame begins with a section called 'frame control', which contains the 'downlink map message (DL-MAP)' along with the 'uplink map message (UL-MAP)'. The map messages define each interval in the downlink (DL) and uplink (UL) frame. Frame control is succeeded by the multiplexer section that broadcasts the data from Base Station to Subscriber Stations.

Four QoS services are provided by Wi-MAX for Uplink:

- Unsolicited Grant Service (UGS), for real time applications that have data packets of fixed size.

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- Real time Polling Service (rtPS), for real time applications that have data packets of variable data size.
- Non-Real Time Polling Service (nrtPS), for non-real time applications that have varying data sizes.
- Best Effort (BE), to provide the services with the Best Effort.

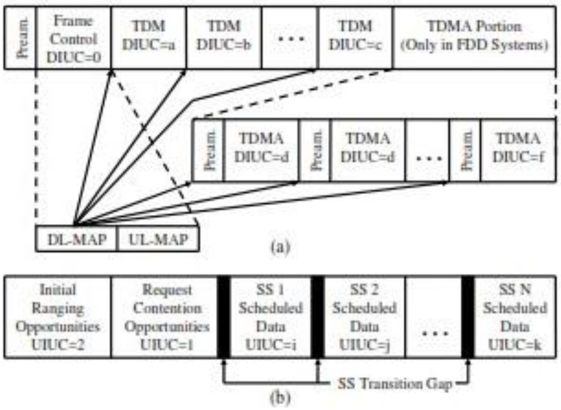

Figure 2. (a) The downlink subframe structure and (b) the uplink subframe structure. The Downlink/Uplink Interval Usage Code (DIUC/UIUC) is a code identifying a particular burst profile that can be used by a downlink/uplink transmission interval.

Fig.2 (b) Basic structure of an uplink sub-frame. Every Subscriber Station is assigned a pre-specified interval. Each Subscriber station then transmits in its own allocation, as specified in the UL-MAP received in the DL sub-frame.

3. Rate Allocation in Wimax Network

In a WiMAX network, rate allocation is necessary for a better QoS and fairness in each user. Problems arising in allocation of rates in a WiMAX network are multiple:

- IEEE 802.16 have multiple services, each having different requirements and needs in terms of quality. Some are real-time services that have either a fixed bit rate or a variable bit rate. Others include non-real time services that have variable bit rate, a best effort service and a bounded delay service.
- Applications in real-time require latency and rate to vary immensely. Also, packet delivery rate varies as per the priority of the packet. It is higher for a video application and lower for a file application.
- Rate allocation is necessary in multiple channels that share a common network. Internet applications usually use the congestion control technique provided by TCP, to control the rate of transmission of data.
- The traffic services in WiMAX system are, rtPS (real-time Polling Service), nrtPS (non-real time Polling Service), ertPS (extended real-time Polling Service), BE (Best Effort Service) and UGS (Unsolicited Grant Service). In previous papers, bandwidth assignment and scheduling were done to increase the performance of these services. Over the period, various modifications have been proposed to improve the media-friendliness.

In our work, we propose a channel condition based rate allocation technique that takes into account the data rate of the application.

4. Simulation Model

The proposed scheme has been implemented using the Qualnet Simulator 6.1 version. The protocol used is IEEE 802.16 MAC. In the simulation scenario, the base station (BS) and clients (SSs) are distributed over an area of 1000×1000 meter region. The simulation time taken is 100 seconds and all the nodes have 250 meters of transmission range. The applications used in the simulation are CBR, VBR and FTP. The simulation parameters are abridged in Table 1:

Table 1 Simulation Parameters

Area Size	1000×1000
MAC	802.16
Clients	30
Radio range	250 m
Simulation Time	600 sec
Routing Protocol	OLSR
Traffic Source	CBR, VBR
Physical Layer	OFDM
Packet Size	1500 bytes
Frame Duration	0.005
Transmission Rate	0.2, 0.5, 1, 2, 3

Fig.4 (a) and 4(b) show the simulation scenario using Qualnet Simulator 6.1 version.

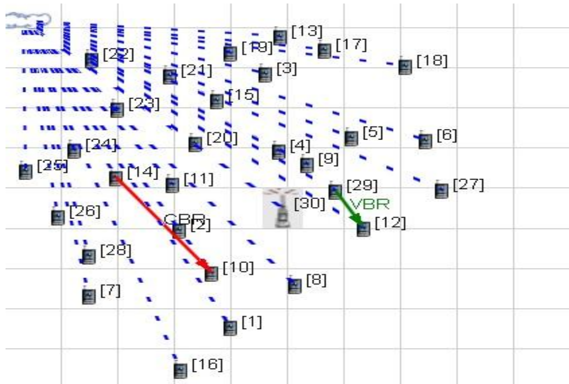

Fig 4(a) Animation view of scenario

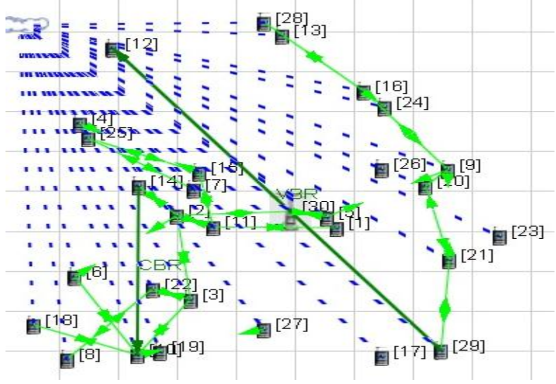

Fig 4(b) Nodes Placement

4.1 Performance Metrics and Results

We evaluate the performance of our applications based on the following metrics:

- **End to End Delay:** We measure the transmission rate of the application against the End to End Delay of each application.
- **Throughput:** We measure the transmission rate of the application against the Throughput of each application.
- **Jitter:** We measure the transmission rate of the application against the Jitter of each application.

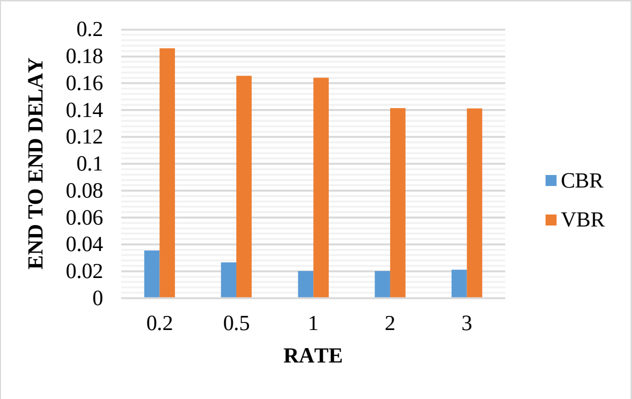

Fig 4(c) End To End Delay

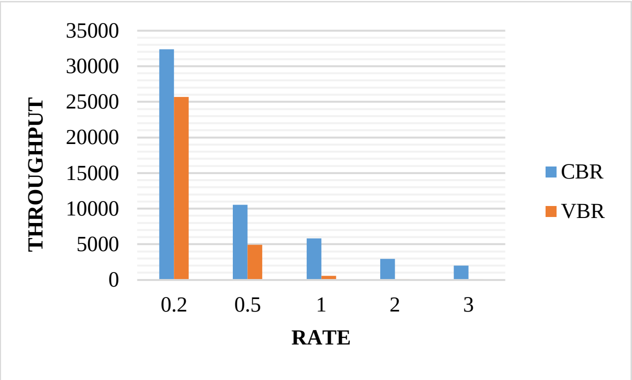

Fig 4(d) Throughput

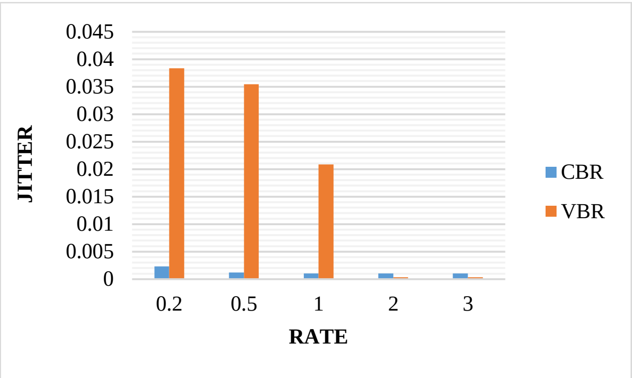

Fig 4(e) JITTER

Conclusions

In this paper, we have performed a performance study of rate allocation in a Wi-MAX network using data traffic. We analyze the average delay and average throughput under various system parameters values. The technique of rate control used in this paper depends on the transmission rate. By simulation results, we have analyzed that the proposed scheme attains an improved throughput and a reduced delay.

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