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JEMIMAH DIGAL
Department of Electronics and Communication Engineering, Karunya University, Coimbatore, India, digal.jemimah.jemimah@gmail.com

S. SMYS
Department of Electronics and Communication Engineering, Karunya University, Coimbatore, India, smys@karunya.edu

ADAPTIVE CHANNEL SPLIT RATIO IN TDD BASED WI-MAX NETWORK FOR LINK IMPROVEMENT ANALYSIS

JEMIMAH DIGAL[1], S. SMYS[2]

[1,2]Department of Electronics and Communication Engineering, Karunya University, Coimbatore, India
E-mail: digal.jemimah.jemimah@gmail.com, smys@karunya.edu

Abstract- The last mile access for residential user are asymmetric. As a result an equal split between the uplink and downlink channel cause inefficient bandwidth utilization. Improper allocation will severely affect the traffic. In this work the main focus is TCP performance during improper bandwidth allocation. The TDD framing in Wi-max is adaptive in the order to make the downlink to uplink bandwidth ratio vary with time. Adaptive channel split ratio, adjust the bandwidth ratio with the help of present traffic profile, transport layer parameters and wireless interference. This scheme will provide higher throughput. The performance of the proposed scheme is validated via ns-2 simulation.

Keywords- *IEEE 802.16(Wi-max), TDD, bandwidth allocation.*

I. INTRODUCTION

IEEE 802.16(Wi-max) is a last mile technology for the broadband wireless access. Wi-max network consist of both base station(BS) and subscriber station(SS). IEEE 802.16 used both frequency division duplex(FDD) and time division duplex(TDD). In FDD uplink and downlink are allocated on separate frequency but data are transmitted simultaneously. In TDD uplink and downlink transmission have same frequency but at different time interval. TDD is adaptive mean downlink to uplink ratio may vary with time to provide better network performance. The downlink from BS to SS, broadcast channel. At the start of each frame BS broadcast MAP control message to inform SS to allocate the time slot to uplink and downlink sub frame. In Wi-max several uplink scheduling mechanisms are there such as unsolicited bandwidth grants, polling and contention. These mechanism support four type of services such as unsolicited bandwidth grants services(UGS), real time polling services (rtPS), non real time polling service(nrtPS) and best effort(BE). In BE scheduling each SS ask for bandwidth connection by sending a request to BS within the bandwidth request contention slot. If any collision occur SS enter to the contention resolution process but in this BE scheduling SS also send the request via piggyback bandwidth request. Major challenge in Wi-max is the proper allocation of bandwidth between BS and SS. As the last mile user are asymmetric, it will cause inefficient bandwidth utilization. This improper allocation effect the TCP, therefore the aggregate network throughput will degrade. So to overcome this failure TDD framing in Wi-max became adaptive so that the uplink and downlink will vary according to the time. The proposed scheme i.e adaptive channel split ratio adjust the bandwidth according to the present traffic profile, transport layer parameter and wireless interference.

II. RELATED WORKS

In this section somerequency divi techniques that are proposed in the literature regarding mobility management and path formation is summarized

In [1] The two link uplink and downlink in Wi-max network defines the medium access(MAC) and physical(PHY) .There are four scheduling services such as unsolicited grant services(UGS), real time poling services(rtPS), non real time poling services(ntPS) and best effort(BE). The main task of the scheduling scheme to satisfy the quality of service(QoS) requirement of the users to utilized the available bandwidth. For uplink this scheduling have to work with the call admission control(CAC) to satisfy the requirement of the QoS. Various scheduling algorithm are accompanied with the IEEE 802.16 MAC layer and OFDM physical layer. There are three type of algorithms such as homogenous, hybrid and opportunistic algorithm. Homogenous and hybrid algorithm are legacy algorithm and hybrid algorithm is multiple legacy scheme.

In [2] In Wi-max network service flow with different priorities. The priority of real time traffic is much higher then the non real time traffic. Bandwidth is limited so it should provided guarantee in real time traffic. Therefore bandwidth control protocol is used. When the bandwidth allocated to real time traffic is insufficient ,the assigned to non real time traffic will reduce. Hence the allocated bandwidth can e adaptive to the real load of real time traffic. If the load of the real time traffic is fluctuate, non real time traffic can borrowed the bandwidth from the real time traffic.

In [3] In order to map the traffic coming from the upper layer Wi-max introduced service specific convergence sub layer (CS). MAC common part sub layer is below CS. It make use of the service given by the MAC service access point(SAP). The CS provide any transformation or mapping of the external network data, received through the SAP. There are two type of CS is present one is ATM CS and other one is packet CS. Packet CS provide packet header suppression(PHS) in order to avoid the redundant information. Payload header suppression index(PHSI) is add only if the payload header suppression option is enable.

III. PROPOSED SCHEME

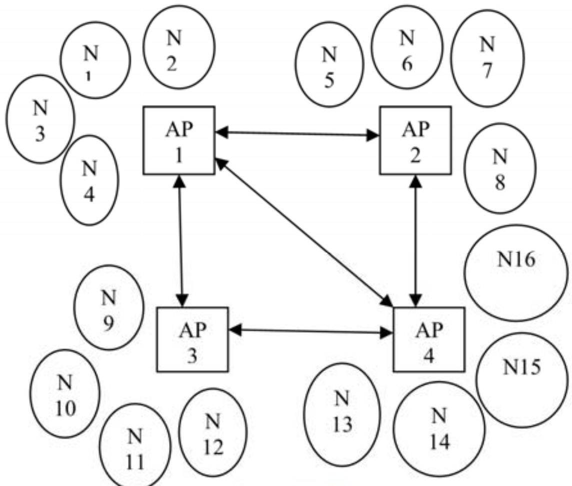

Fig.1 model structure

Fig.1 shows the model structure. The scenario depits that four access point are present. Each oh these are surruonede by four nodes. These nodes are within the rang of there respetive access point . The access point are cneected in a mesh network. The nodes which are present are mobile in nature. Here AP indicate the access point and N1……N16 indicate the nodes. These scenario is being patch in Wi-ax module to prove that these is a WIi-max network. There are certion parametre being uesed such as IPVP6, 16 QAM modulation, OFDM(physical layer) and NOAH routing. In IEEE 802.16 bandwidth request is made per connection. Each request is made with the best effort scheduling services through broadcast connection mechanisim. These scheduling service is based on first come first served. The bandwidth ratio is analysied by two link , they are as follows

A. Bandwidth asymmetry ratio of TCP over a direct link

As it is a asymmetric uplink and downlink ratio are improper. K is called as the bandwidth asymmetry ratio. K is defined as follows

$$\frac{\text{Rate of the TCP data packet}}{\text{Rate of the TCP ACk packet}}$$

TCP data packet are transiting in downlink path and the ACK are transiting in uplink path. When k is less then or equal to one i.e TCP is functioning good. If it is not so then ACK will be bottleneck which will cause more traffic. As a result the system performance will degrade.

B. Bandwidth asymmetry ratio for Wi-max

These asymmetric ratio only support point to point not for the multi point. Therefore Wi-max network use TDMA MAC protocol. There are two way is consider that is data and ACK packet are in both the direction and other one is multiple TCP transfer. Suppose ηdss downloading TCP transfer and ηuss uploading TCP transfer both are present in the network. Downlink and uplink bandwidth data and the ACK packet are being share by the SS. Therefore the asymmetry ratio for the downloading user ηd is given by

$$\eta d = \alpha * Bd * Tusv \div Ldata * \eta dss$$

$$\alpha = \eta dss * Ldata \div \eta dss * Ldata \pm \eta uss * Lack \div d$$

Where, Tusv = $Lack \div d * Bu$

ηdss = Asymmetry ratio for downlink user.

ηuss = Asymmetry ratio for uplink user.

Ldata = The size of the one TCP data packet in term of bits.

Lack = The size of the one TCP ACK packet on term of bits.

Bd = The downlink channel capacity in term of bits.

Bu = The uplink channel in term of bits.

Similarly asymmetry ratio for the uplink user ηu is given by

$$\eta u = 1 \div Tusv * Lack * \eta uss$$

C. Adaptive channel split ratio adjustment mechanism

The scheme is develop to provide the asymmetry ratio for downlink(ηd) and asymmetry ratio for uplink(ηu) should be equal to one i.e ηd=ηu=1. As the traffic of the network changes with the time the proposed scheme can be performed periodically. There are certain step which have to be followed.

Step 1: BS collect the information about the number of downloading TCP transfer in the system(ηdss) and the number of uploading TCP transfer in the system(ηuss). To obtain whether the connection is a uplink or downlink connection.

Step 2: Determine whether the bandwidth asymmetry ratio is less then or equal to one(ηd=ηu=1).

Step 3: After getting the ratio from the step 2, it can be adjust the split between uplink and downlink as follows

$$Nu = m \div n + (Nf - Nc) + Nc$$

$$Nd = m \div n + n(Nf - Nc)$$

Where, Nu= Total number of the time slot allocated for uplink channel.

Nd= Total number of the time slot allocated for downlink channel.
Nf= Total number of time slot in one TDD frame.
Nc= Number of time slot for the contention period in a frame.
Step 4: After being adjust the splitting between uplink and downlink BS will inform SS to adjust according to the obtain value from step 3. BS then inform the scheduler module about bandwidth in the downlink and uplink direction for proper operation.

IV. PERFORMANCE ANALYSIS AND SIMULATION RESULTS

In the proposed work, adaptive channel split ratio adjust the bandwidth according to the scenario. The ASR(adptive channel split ratio) curve is being compare with the two static curve, that are DL:UL=2 i.e 2:1 and DL:UL=1 i.e 1:1. The simulation is being divided into two scenario. In the first scenario only deals with the downlink TCP transfer and in the second it deals both downlink and uplink TCP transfer. The performance of the network is view with the help of ns-2.

Scenario 1
In these first scenario the number of TCP transfer in the network are like 5, 10 and 15. The TCP transfer which are consider here downlink. The figures which are below show the aggregate downlink throughput versus number of TCP transfer and the access dealy.

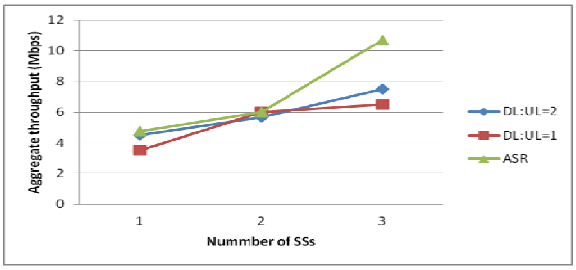

Fig 1 Aggregate throughput

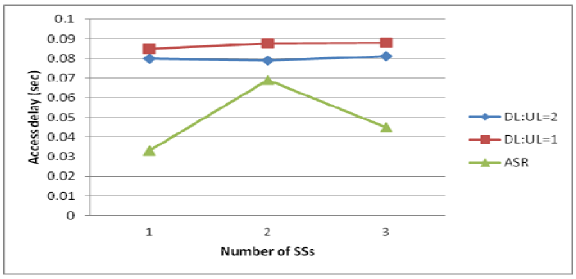

Fig 2 Access delay

Throughput is the average rate of successful message delivery over a communication channel. The aggregate throughput s the sum of data rate that are delivered to all the station in a network. The access delay is the time from when the source generate the data untill it reaches the destinatio. It include the processing delay, queuing dealy and transmission delay. As the figure depits that the proposed scheme generate the higher aggregate downlink throughputover the number of TCP ransfer in the network. Improper bandwidth allocation leads to the bottleneck and degrading the network throughput. Hence ASR comput with the two static DL and UL ratio and proved better aggregate throughput. Here it also provied small average access delay. Though the numer of TCP transfer in the network is large the proposed scheme enable the network to maintain a small acess delay. Hence it can be conclude that the proposed scheme can able to provied higher throughput and lower access delay as compare with the static approach.

Scenario 2
In these second scenario the number of TCP transfer in the network is vary at 15 and vary oth the downloading and uploading TCP transfer in the network. The figures which are below show the aggregate downlink throughput and the aggregate uplink throughput.

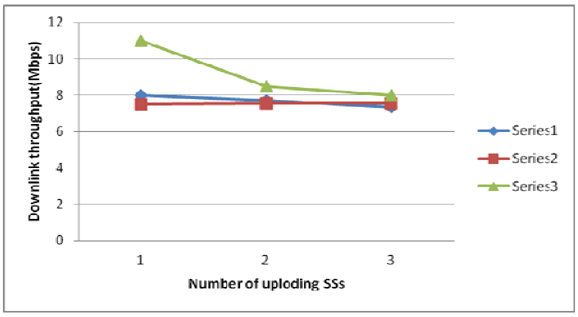

Fig 3 Aggregate downlink throughput

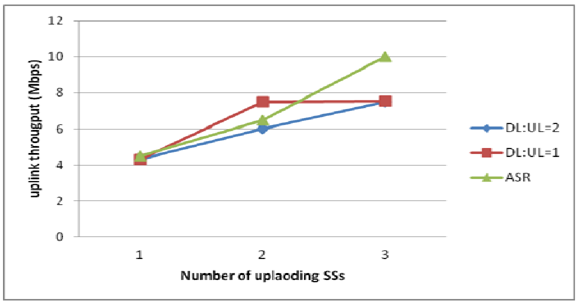

Fig 4 Aggregate uplink throughput

Throughput is the average rate of successful message delivery over a communication channel. The aggregate throughput s the sum of data rate that are delivered to all the station in a network. Downlink throughput deal with the number of TCP transfer during downloading and uplink throughput deak with the numbr of TCP transfer during uploading in the network. In these scenario the downloading and uploading take place simultaneously. The proposed scheme provied better aggregate throughput in both the direction which is proportional to the number of TCP transfer in that direction. This shows that the scheme provied better TCP connection despite of there direction. ASR generate higher aggregate throughput in both the direction as compared to the static approaches. Because it adjust the DL and UL ratio according to the number of downloading and uploading TCP transfer. The static approaches uses a fixed downlink and uplink bandwidth ratio, which create bottleneck in either direction. As a result the system performance will reduce.In the case of ASR it prevent the formation of bottleneck. Therefore the proposed scheme is used to provied the better aggregate throughput in both direction.

V. CONCLUSION

Wi-max is a last mile broadband wireless access. The access for the residential user are more asymmetry i.e they are more concerning on downloading rather then uploading. Therefore the bandwidth allocated for both uplink and downlink get disturb. As a result the system performance reduce. To overcome this a TDD based IEEE 802.16 wireless network is used. Here the TDD based Wi-max network is being adaptive so that it can vary the uplink and downlink bandwidth ratio according time. As the access is asymmetry traffic is severely affected, therefore the main focus is to verify the TCP performance over the improper allocation of bandwidth. Adaptive channel split ratio scheme is being proposed to adjust the bandwidth ratio adaptively according to the present traffic profile, transport layer parameter and wireless interference. ASR along with BS scheduler prevent the TCP source being bottleneck in either direction i.e downlink or uplink when acknowledgement are transmitted infrequently. Best effort(BE) scheduling service not only provide service to the existing internet application such as web browsing, FTP, P2P file sharing but also it help the SSs to send the bandwidth request through piggybacking. The simulation result show that the proposed scheme achieved higher aggregate throughput.

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