QoS Scheduling in Wireless MAN

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ABSTRACT
Wire line infrastructures can be considerably more expensive and time consuming to deploy than a wireless one. In addition, rural areas and developing countries frequently lack optical fiber or copper-wire infrastructures for broadband services and providers are unwilling to install the necessary equipment for regions with little profit potential. Wireless approaches could address this problem. Wireless communication poses special problems that do not exist in wired networks, such as time varying channel capacity and location dependent errors. The work proposed focuses on the QoS aspects like maximum bandwidth utilization and fairness. The conventional scheduling algorithms available are not meeting the necessary QoS parameters. So we are proposing a novel Neurofuzzy based Scheduling Algorithm.

Keywords
QoS, fuzzy, neural, WiMAX, WMAN.

I. INTRODUCTION

There are many new wireless access technologies and standards under development today, looking to extend mobility, data rates and user services and thus filling a position in the future generation networks. The building blocks of these networks are however uncertain due to this technology diversity. Mobile communications, originating from fixed circuit switched voice traffic in public phone networks, has evolved to support stringent QoS and packet-based traffic together with global mobility. The telecom industry expects data rates to reach 100 Mb/s with the new Super 3G networks as a part of 3GPP's Long Term Evolution of 3G networks. Before that Turbo 3G will enable data rates of 14 Mb/s as an extension to deployed3G networks with High Speed Downlink Packet Access,

HSDPA. The Internet Protocol (IP) technology, with front figures such as IEEE and IETF2, has gone from indoor, fixed high speed networks with 802.11, to outdoor wireless access with support for mobility with standards such as access with support for mobility with standards such as 802.16 for broadband wireless access, 802.21 for mobility between networks and 802.20, the all-mobility standard. WiMAX, based on IEEE 802.16 attempts to bring quality of services, high data rates and coverage to wireless computers networks and to work as a "last mile" solution for end user access. This technology shows promise in filling the gap between 3G and Wireless LAN (WLAN), a gap where the superior QoS of cellular networks are combined with the flexibility and scalability of IP technology. As WiMAX[1] is currently under development with parts of the 802.16 standard being complete, this is an interesting case for an observational and comparative study. Will WiMAX meet the goals of its creators and the market, and what issues can be expected to arise during development and deployment. This work serves as an orientation on the subject of scheduling the QoS parameters for mobile WiMAX IEEE Std. 802.16. This orientation is done in comparison with other scheduling algorithms as a frame of reference.

II. RELATED WORKS

Although a number of packet scheduling algorithms have been proposed for WiMAX network, the design of those algorithms are challenged by supporting different levels of services, fairness, and implementation complexity and so on. C.Cicconetti and L.Lenzini consider two types of queues [1]. The first type is used to schedule data grants for Unsolicited Frant Service (UGS) and allocate request opportunities for rtPS and nrtPS. These grants are scheduled in a first in first out (FIFO) manner. Once the first queue type has been served, the scheduler will consider the second type. The second type of queues are used for scheduling data grants for rtPS, nrtPS and BE based on the information contained in the bandwidth request sent by the respective SS. Here, the BS scheduler first of all distributes the reserved bandwidth as determined by the bandwidth request messages. The residual bandwidth is distributed in a weighted queue manner.

J. Sun, Y. Yao, and H. Zhu , have developed an analytical model of MAC protocol for BWA(broadband wireless access) systems with a traffic scheduling mechanism based message and SSs priorities[2]. The authors divide uplink sub-frame into Transmission interval and TDMA interval (or reservation interval) with dynamically changing the length of these two intervals. TDMA interval is used by each of the stations to inform the BS about the services for which a bandwidth reservation is being requested, as well as the number of packets to be transmitted for each of those services. In TDMA interval each station gets only one slot to send the above specified information to BS(base station). This information could be different for different stations. The authors proposed two versions of their analytic model; version 1 is more focused on degree of fairness in the access to the media between the stations of the network while version 2 a station transmits all its messages before one of lower priority. The authors do not present any calculation to show how to dynamically calculate the length of Transmission interval and TDMA interval. Moreover the calculation of average waiting time is calculated in terms of number of slots but the length of one slot is not mentioned in paper.

S.A. Xergias, N. Passas, and L. Merako, the proposed packet scheduler assigns priorities to the packets to be transmitted, based on the channel status reported by the user equipments as well as the QoS statistics maintained by the BS[3]. Since the scheduler works in a global timeline, a time utility function (TUF) is used for the scheduling. In the first step, the incoming packets are stored in the buffer corresponding to the SS and the traffic type. The QoS profiles of each arrived packet are also maintained.

Aura Ganz and Kitti Wongthavarawat suggest uplink bandwidth allocation algorithms based on flow type and strict priority from highest to lowest - UGS, rtPS, nrtPS and BE. For UGS flow fixed bandwidth is allocated, for rtPS flows Early Deadline First (EDF) service, for nrtPS WFQ and remaining slots allocated for BE flow. An overall bandwidth allocation module is proposed to stop higher priority flow to use more than their allocated bandwidth. The authors use simulation model developed in C++ to show the effectiveness of their algorithm.

1. FUZZY PRIORITY SETTER

A. Introduction

Fuzzy logic refers to a logical system that generalizes classical logic for reasoning under uncertainty. In a broad sense, fuzzy logic refers to all of the theories and technologies that employ fuzzy sets, which are classes with unsharp boundaries. Fuzzy logic generalizes notion of truth-values in classical logic into a matter of degree [5]. An important goal of fuzzy logic is to be able to make reasonable inference even when the condition of an implication rule is partially satisfied. This capability is sometimes referred to as approximate reasoning. Fuzzy logic concept can be used to deal with the imprecise and uncertain information since the network is dynamic in nature. When applied to appropriate problems, fuzzy systems give a faster and smoother response and less complexity compared to conventional systems. Basically the fuzzy system consists of four blocks, namely, fuzzifier, defuzzifier, inference engine, and fuzzy knowledge base. The following explains the working of the general fuzzy system.

A. Primary Fuzzy Scheduler

The incoming requests in the WiMAX have different variables that play a key role in setting the priority of that particular request. The variables are Expiry Time, Waiting Time, Queue Length, Packet Size and Type of Service. In the proposed fuzzy scheduler we use two different stages namely the Primary Scheduler, FS1 and the Dynamic Scheduler, FS2. This proposed scheduler is named as Dynamic Fuzzy based Priority Scheduler (DFPS). In the proposed Primary Fuzzy Scheduler we used four inputs namely, Expiry time (E), Waiting time (W), Queue length (Q), Packet size (P) and one output, Priority index. Here, the process is considered as multiple input and single output (MISO) system

IV. ARTIFICAL NEURAL NETWORKS (ANN)

B. Introduction

The next step is scheduling of the prioritized input received from the DPFS. Since neural networks have high computational speeds we decided to use ANN. A neural network is a massively parallel-distributed processor that has a natural propensity for storing experiential knowledge and making it available for use. Artificial neural network is a nonlinear signal-processing device, which is built from interconnected elementary processing devices called neurons. Either humans or other computer techniques can use neural networks, with their remarkable ability to derive meaning from complicated or imprecise data, to extract patterns and detect trends that are too complex to be noticed. A trained neural network can be thought of as an "expert" in the category of information it has been given to analyze. This expert can then be used to provide projections given new situations of interest and answer "what if" questions.

An ANN can have the following features:

1. Adaptive learning
2. Self-Organization
3. Real Time Operation

The artificial neuron was designed to mimic the first-order characteristics applied, each representing the output of another neuron

C. Proposed ANN

The proposed ANN (Artificial Neural Network) is shown in The first layer is the input layer and the second layer is the modified form of Kohonen layer. The final layer is the modified form of Grossberg layer. The proposed ANN deals with the efficient allocation of the available bandwidth based on the Priority Index set by the DFPS with a measure of Fairness to all the service classes.

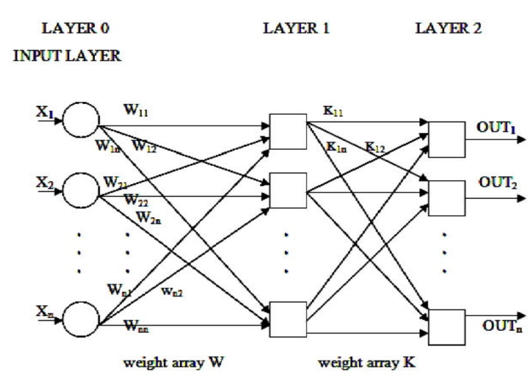

Figure 1: *Proposed ANN*

The input layer receives the prioritized outputs from the DFPS. These inputs are organized in the order of their priority. Now the output of this layer is given as the input to the modified Kohonen Layer. The modified Kohonen layer is used to predict whether the given input is within the threshold value. Depending on the availability of the channel bandwidth the threshold value is set. If the incoming request is below the threshold value then that request is forwarded to the next layer, the Grossberg layer. If not, that request is rejected. But it happens on extreme circumstances. In the Grossberg layer, the inputs are summed up and it calculates how many requests can be granted within the threshold. The action of each neuron in the Grossberg layer [6] is to output the value of the weight that connects it to the single nonzero Kohonen neuron.

V. SIMULATION

The Neuro-fuzzy based scheduling algorithm was tested using C++ and MATLAB simulation environment. A threshold value was set here at first. Then the number of hits was received along with their individual expiry time, waiting time, queue length, type of service and band width. The algorithm was designed in such a way that it used almost all of the available resources allotted to the particular Internet Service Provider or BS. It uses two stages. In the first stage the parameters waiting time, expiry time, queue length, type of service and packet size are given to the fuzzy priority setter. A priority index for each request was set and was given to the ANN scheduler that compares the bandwidths of the individual requests that are to be scheduled. With the C++ environment granted requests have been studied and channel utilization was recorded.

VI. RESULTS :

On simulation using a NS-2 simulator we observe the following results: when we use this algorithm the maximum bandwidth utilization is around 90 to 100 percentage. It also provides fairness by allocating the unutilized channel to the lower priority services. The processing time for this algorithm is in millisecond which implies that the delay and jitter is low. The graph in figure.2 shows the performance analysis based on percentage of requests granted.

Type of service	Percentage Of request granted
0	*30*
1	*100*
2	*50*
3	*50*
4	*100*

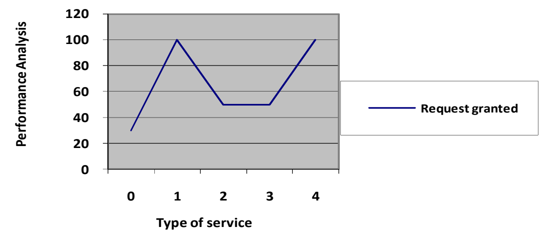

Figure.2: Performance analysis based on requests granted

VII. FUTURE ENHANCEMENT

We have used neural fuzzy algorithm and deployed our results that it is the most efficient algorithm for QoS scheduling in WMAN. In future this can be deployed using latest other algorithms for better results.

VIII. CONCLUSION

Going by the simulated results our algorithm performance is better than the presently available conventional wireless scheduling algorithms. Moreover this simulated algorithm can be implemented in the real life applications once the necessary infrastructure is available.

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