THE MODEL OF SCHEDULER FOR WiMAX NETWORK IN THE PRESENCE OF AGGRESSIVE SUBSCRIBERS WITH ESTIMATE INTENSITY SERVICE

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Abstracts

In this article was proposed a new model of scheduler for WiMax network with "aggressive" subscribers. To compare the proposed scheduler with the well-known "Round Robin" scheduler there was made a simulation and its results demonstrates the advantage of the proposed scheduler: the speed of service requests of "non-aggressive" subscribers is increase.

I. INTRODUCTION

The problems of Wireless network become more actual nowadays. Number of users who overload network with large amount of non-priority data (aggressive subscribers), such as media content, is growing. Due to heavy load on the 4G network the speed of service of subscribers with small traffic (non-aggressive subscribers) comes low. Let's consider the principles of WiMax network.

II. DESCRIPTION OF THE SYSTEM

The most of the networks operate according to the standard IEEE 802.16e. The networks of this standard use "star" topology. It means that each subscriber station (SS) is connected to the base station (BS) directly.

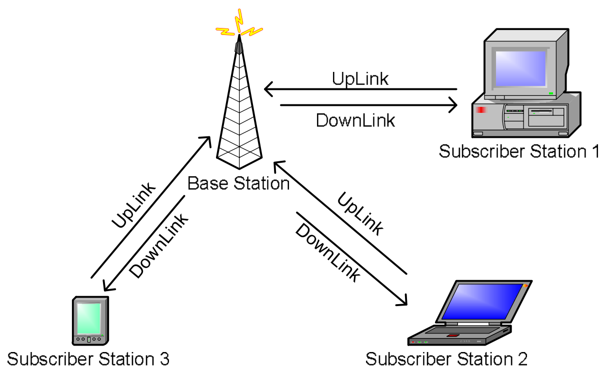

Fig. 1. Topology of network

Exchange of the information between BS and SS is carried out with using a sequence of frames. The frame can be contingently divided into 3 parts: the exchange of technical reports and 2 subframes: UpLink, where the data is transferred from SS to BS, and DownLink, where the data goes from BS to SS.

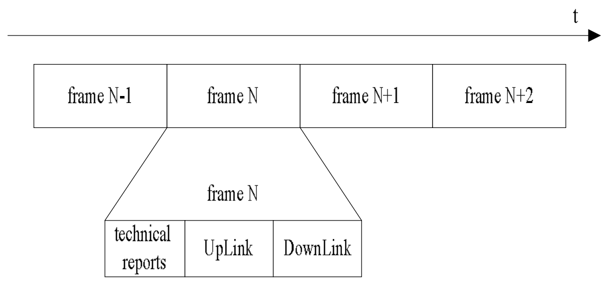

Fig. 2. Summarize structure of frame

All data transfer in the network is strictly synchronized and assigned by the BS. To begin transferring the data SS has to send the request for resource of channel (RRC) to the BS.

A scheduler allocates the resources for data transmission in the frame. It determines which amount of data the SS can send and/or receive in each frame. Scheduler of resource allocation in the frame is not specified by the standard. Correct choice of discipline of planning can compensate the negative effect delay of data transfer for not-aggressive subscribers. Let's consider the most common types of schedulers.

III. THE "ROUND ROBIN" SCHEDULER (RRS)

This scheduler is used for network IEEE 802.16 simulation. For each subscriber its own buffer is started up onto the BS. After successful delivery of request message onto the BS, the information about RRC is to be recorded into the buffer of requests of the subscriber. Each frame the scheduler sequentially queries the buffers of subscribers. If the buffer is not empty the scheduler picks one RRC and includes the data of the subscriber and allocated resources into the frame. Buffers are queried cyclically, if the resource of the frame is over and RRCs still remain then the next frame the scheduler start queried from buffer next to those where it stopped. If some buffers of subscribers are empty then the other subscriber may get more resources in the cells of the frame respectively the order of queried. If the resources aren't ending in the frame but RRC in the buffers is ended, the remaining cells in the frame are filled with zeros. [2]

Consider the work of this scheduler in the presence of aggressive users. The buffer of requests of aggressive subscriber are always has RRC. It means that for each cyclic queried of buffers this scheduler have to provide it with at least M units of a resource in the frame. There are resource channel X and the presence M of aggressive subscribers, for other subscriber's N resource of the channel is equal to: $X\frac{N-M}{N}$. The scheduler "Round Robin" doesn't fix the history of RRCs of subscribers, and aggressive subscriber can take the most of the scheduler's queue, thereby greatly worsening the data rate for remained subscribers.

IV. THE PROPORTIONALLY FAIR SCHEDULER (PFS)

This scheduler is recommended by leading developers of wireless solutions. The proportionally fair scheduler, in its simplest form, computes a metric for all active users at for a given scheduling interval. The user with the highest metric is allocated the resource available in the given interval, the metrics for all users are updated before the next scheduling interval, and the process repeats. Note that the number of resources eventually allocated to a user depends on the metric update process, and does not preclude a single user from getting multiple or all the resources in a frame. [3]

Calculations of subscribers' metrics were considered in article [5] in detail.

Scheduling Metric is a characteristic which determine the priority service of the subscriber by BS's scheduler. Changing the priority of the subscriber depends on changes in the quality of communication: the more intensively improving communication quality – the higher the priority of the subscriber. Consequently, if the quality of the subscriber does not change significantly, the change of the metric does not happen. This leads to conversion of this scheduler to "Round Robin" type that was previously considered.

V. THE ESTIMATE INTENSITY SERVICE SHEDULER (EISS)

The scheduler of circular query serves to all subscribers sequentially, without analyzing the queue of each subscriber and if the non-aggressive subscriber with low-intensity sends a request it will be served only in the order queue, despite the high intensity of other subscribers. To improve the quality of service of non-aggressive subscribers offered to following discipline of query of buffers. Enter metrics that calculate as estimate of intensity of service of subscribers for latest several frames. Thus the highest priority in current frame belongs to subscriber who has the smallest quantity of served request in the latest N frames (N – parameter of algorithm of query). If there are several of such subscribers then they are served by random order. Such discipline of planning is allows to provide the smallest delay in service for non-aggressive subscribers.

VI. RESULT OF MODELLING

To compare average delay of service of subscribers in network with different scheduler, there was made a simulation that conforms to standard of modeling WiMax network. The purpose of simulation was to compare the scheduler "Round Robin" and the scheduler Estimate Intensity Service because the Proportionally Fair Scheduler is similar to RRS in considered conditions (constant quality of data transferring).

The simulation was performed for the following conditions (Table 1). In this model common maximal traffic rate of non-aggressive subscribers (*Vnormal*) is $V\max = 3.5$ Mb/s, and it's changing accordingly to proportion of non-aggressive subscribers in common quantity (*Pnormal*) $Vnormal = Pnormal \cdot Vmax$. The common maximal traffic rate of aggressive subscribers (*Vaggr*) is changing in process of simulation accordingly to proportion of aggressive subscribers in common quantity (*Paggr*) $Vaggr = K \cdot Paggr \cdot V\max$, where K is coefficient of aggressiveness. The proportion of aggressive subscribers is changed from $Nabon \cdot 10\%$ to $Nabon \cdot 90\%$.

In the result of modeling were obtained the graphs which show average delay of requests as non-aggressive subscribers (measured in frames) for RCC (Fig. 3) and EISS (Fig. 4), as aggressive subscribers (Fig. 5), in conditions of increasing proportion of aggressive subscribers (from 10 to 90 percent) from common quantity of subscribers.

Table 1.

Parameters of the modeling system

Time of simulation	4 minutes of real time of the system's work
Amount traffic rate in channel of all subscribers	From 4.9 to 16.1 Mb/s
Common quantity of served subscribers	30
Maximal common traffic rate of non-aggressive subscribers	3 Mb/s
Proportion of aggressive subscribers	From 10% to 90% of subscribers common quantity
Coefficient of aggressiveness	5
Size of one request of subscriber	1536 bit
Duration of frame (sec)	0.005

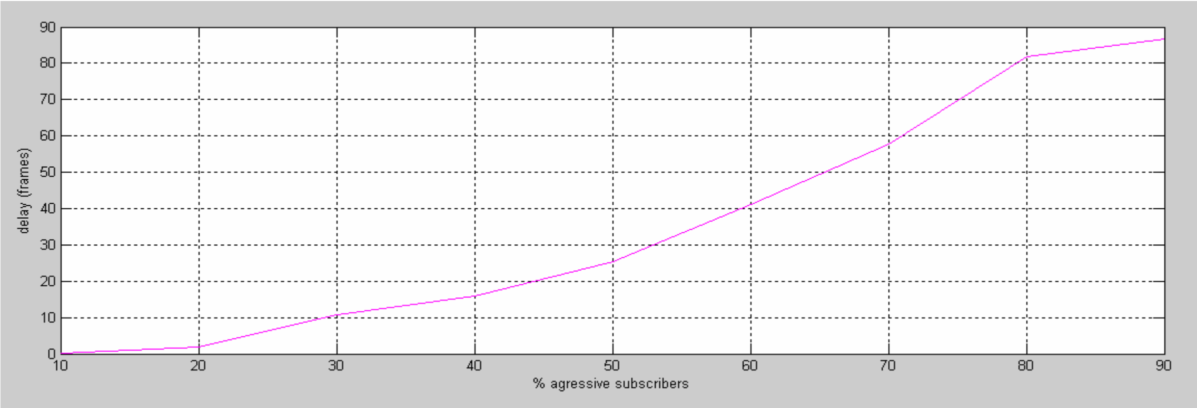

Fig. 3. Average delay for non-aggressive subscribers for RRS

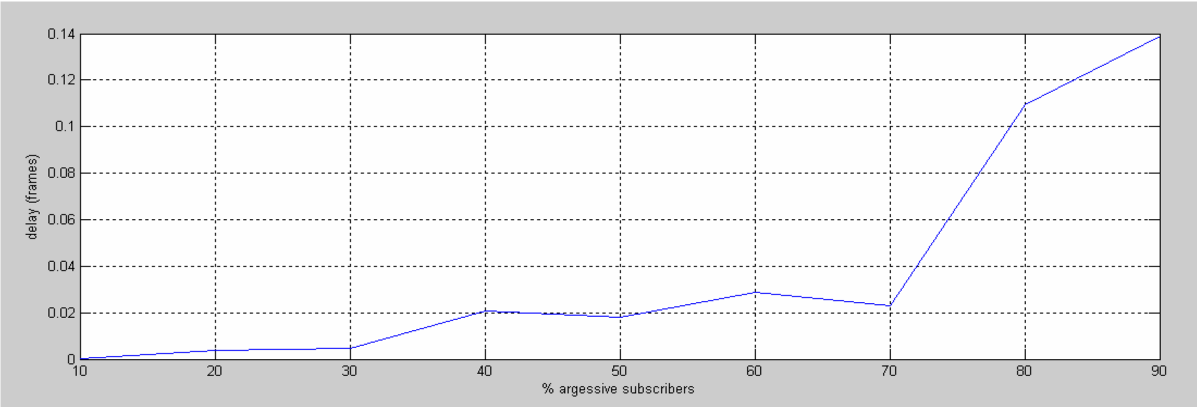

Fig. 4. Average delay for non-aggressive subscribers for EISS

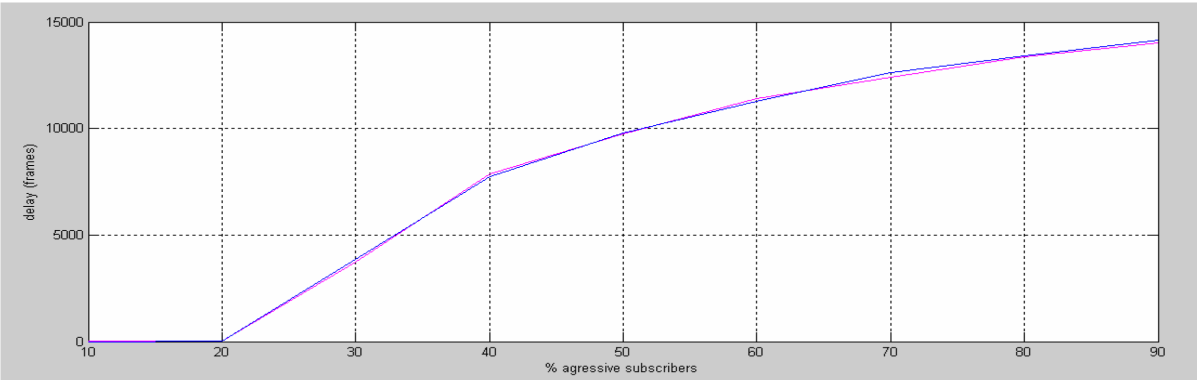

Fig. 5. Average delay for aggressive subscribers for EISS and RRS

VII. CONCLUSION

After considering those graphics next conclusions were made:

1. In the case of aggressive subscribers the schedulers work almost identically.
2. In the case of non-aggressive subscribers EISS provides significantly less delay then services RRC (with an increasing in the proportion of aggressive subscribers the delay increases to several orders of magnitude).

The proposed scheduler of service requests allows at comparison with RCC significantly reduce the delay of service requests from non-aggressive subscribers while maintaining the delay in servicing requests from aggressive subscribers.

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