RESOURCE DISTRIBUTION DISCIPLINES FOR WIRELESS REGIONAL NETWORKS

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Abstract

In this article considered the main feature of system of distribution the resources in according to the standard regional network IEEE 802.16. It is scheduler of allocated the resources in the frame. And in article is analyzed the most famous types of schedulers and their quality and shortcomings.

I. INTRODUCTION

Nowadays, wireless technologies are increasingly replacing wired. Growing number of users need mobility, it's mean, that subscribers need an opportunity to access to global and local networks, regardless of where are they. The solution of these problems can be found in introduction of wireless networks the fourth-generation. 4G technology solves the problem of subscribers mobility by means of new standards for wireless data transmission. One of the main directions of research in the 4G technology is the creation of high-speed wireless access networks to the Internet.

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 (fig. 1). It means that each subscriber station (SS) is connected to the base station (BS) directly.

Exchange of the information between BS and SS is carried out 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).

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. Delivery Methods of RRC can be both sporadic and planned. In the first case, requests are implemented by a special package that is to be sent on competitive basis in specially allocated interval. The procedure of planned RRC is carried out by different pollings, when the BS periodically asks the SS for needs of channel resources. [1]

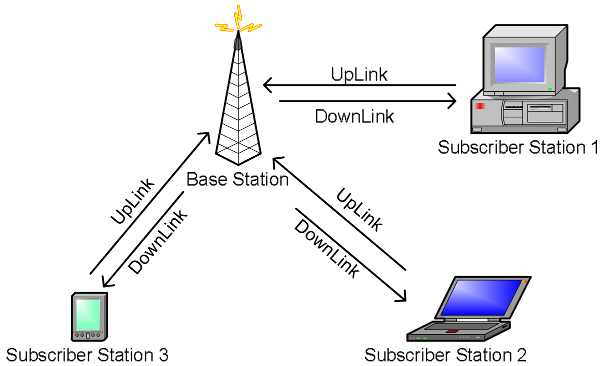

Fig. 1. Topology of network

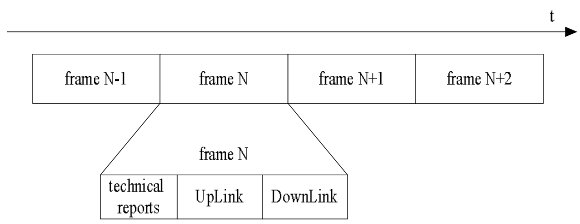

Fig. 2. Summarize structure of frame

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. According to research carried out by the European company Danske Telecom, 5% of active users during the hours of peak activity can create unfavorable conditions for the last 95% [1]. Correct choice of discipline of planning can compensate this negative effect. Let's consider the most common types of schedulers.

III. THE SCHEDULER "ROUND ROBIN"

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. This 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. PFS SCHEDULER (THE PROPORTIONALLY FAIR SCHEDULER)

This scheduler is recommended by leading developers of wireless solutions. The proportionally fair scheduler (PFS), 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]

The metric is calculated by equation (1).

$$M_i(t) = \frac{T\_inst_i(t)}{\left[T\_average_i(t)\right]^{\alpha}}, \qquad (1)$$

where $M_i(t)$ – subscriber's metric; $T\_inst_i(t)$ – is the data rate that can be supported at scheduling instant t for subscriber i; α – is a fairness exponent factor with default value 1; $T\_average_i(t)$ – is throughput smoothed by a low-pass filter at the scheduling instant t for user i.

$T\_average_i(t)$ for the planned RCC calculated by the equation (2).

$$T\_average_i(t) = \frac{1}{N_{PF}} T\_inst_i(t) + \left(1 - \frac{1}{N_{PF}}\right) T\_average_i(t-1) \qquad (2)$$

And for unplanned RCC by equation (3).

$$T\_average_i(t) = \left(1 - \frac{1}{N_{PF}}\right) T\_average_i(t-1) \qquad (3)$$

Scheduling Metric – a characteristic, which determines the priority service the subscriber by BS's scheduler. Change 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. CONCLUSION

The main disadvantages of the considered disciplines of planning are in the absence of analysis of the history of RRCs. This allows to aggressive subscribers to take the most of the resources of the channel. This leads to a worsening of the quality of service for other subscribers. Accordingly, a promising and important task is to develop the discipline of planning free of these shortcomings.

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