THE DEVELOPMENT OF A SIMULATION MODELING OF TRAFFIC PRIORITIZATION IN MULTISERVICE ENTERPRISE NETWORKS IN THE ANYLOGIC SYSTEM

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Abstract

This thesis is devoted to the results of the development of a simulation model for the analysis and planning of traffic prioritization in multiservice enterprise networks. There were collected the main characteristics of the data network and types of traffic. Prioritization technique is selected for simulation. A model is constructed in the Anylogic simulation modeling system. The analysis of traffic flows and dependence of the quality of traffic transmission from various events are shown graphically.

Keywords: traffic prioritization, Anylogic, multiservice networks

1. Introduction

This thesis is devoted to the analysis, planning and modeling of traffic prioritization processes in multiservice enterprise networks. Currently, in corporate networks, while the auditing and analyzing traffic flows passing through the data transfer network (hereinafter DTN), it is noticed that traffic of different types, protocols and levels of the OSI model is transmitted through the DTN. It could be voice traffic coming from IP phones or PBX, real-time video traffic arising from video conferences between branches; various traffic of management and maintenance of equipment and network infrastructure (keepalive, heartbeat, sync,...), etc. The data transfer network has its own metrics allowing to assess its quality. The works [1-2] are devoted to the design of multiservice networks and DTN based on simulation modeling. It is possible to highlight the following characteristics of a network important for an estimation:

1. Bandwidth capacity. Bandwidth capacity describes how much the data could be transmitted and received through the data link per time unit.
2. Network throughput. Throughput describes the quantity of useful data that could be transmitted and received for certain time unit. Otherwise, the network throughput measures the speed of messages successfully delivered to the recipient.
3. The rate of frame loss. This characteristic describes how many frames were lost in the transmission process for various reasons.
4. Delay (latency) describes the time passed from the sending a package from point A and its receiving at point B.
5. Jitter shows the variety of delay in relation to the neighboring frames.

Each type of the traffic also has its own characteristics and requirements for its transmission. For instance, for transmission of voice traffic it is critical that the delay of network should be at minimum level as well as there no frame losses and jitter should be unchanged. For the video traffic there are important all these abovementioned features, but the frame loss is not so critical in case that its loss is not more than 30%. For other types of traffic, the requirements for the quality of communication channels are even less.

Because of the width of the data link always has the limit of bandwidth capacity, it is highly important to ensure that each type of traffic does not occupy the entire bandwidth. Otherwise, it will negatively affect the transmission quality of other types of traffic. In order to prevent this, it is used traffic prioritization to guarantee the quality of service (Quality of Service, QoS). Traffic prioritization allows to set the most important traffic a higher priority in order to improve the QoS metrics of this traffic by degrading the QoS metrics of low-priority traffic.

The switch can use buffering to temporarily store packages and then send them to the correct address. The buffering can also be used when the destination port is busy. A buffer is an area of memory in which the switch stores the transmitted data.

A memory buffer can use two methods to store and send packages: port buffering and shared memory buffering. While port buffering the packages stores in queues that are associated with individual input ports. A packet is transmitted to the output port only when all packages ahead of it in the queue have been successfully transmitted. In this case, it is possible that one package delays the entire queue due to the busy port of its destination. This delay can occur even when the remaining packages can be transferred to the open ports of their destinations.

While buffering in shared memory, all packages are stored in a common shared memory buffer that is used by all ports on the switch. The amount of memory allocated to a port is determined by the amount of memory it requires. This method is called dynamic buffer allocation. Then the packages in the buffer are dynamically allocated to the output ports. This allows to receive a package in one port and send it from another port without having to queue it. [3].

The priority queueing technique was used to prioritize traffic during buffering. *Priority Queuing (PQ)* provides unconditional priority of some packages over others. There are 4 queues: high, medium, normal and low. Processing is carried out sequentially (from high to low levels), starting with a high priority queue, and until it is completely cleared, it does not move to lower priority queues. Thus, it is possible to monopolize the data link with high-priority queues. Traffic whose priority is not specified will be queued by default.

2. Implementation of the model

To create a simulation model the traffic was divided into four classes:

1. Audio traffic – class with high priority.
2. Video traffic – class with second priority (medium).
3. Traffic management – class with third level of priority (normal).
4. Other traffic – class with less level of priority (low).

On the basis of this the simulation model was created in Anylogic [4] system that could measure the following indicators of traffic:

1. The quantity of packages of each type in queues
2. The percentage of packages of each type
3. The quantity of transmitted frames.
4. The quantity of lost frames.

The result of program work is shown on the figure 1.

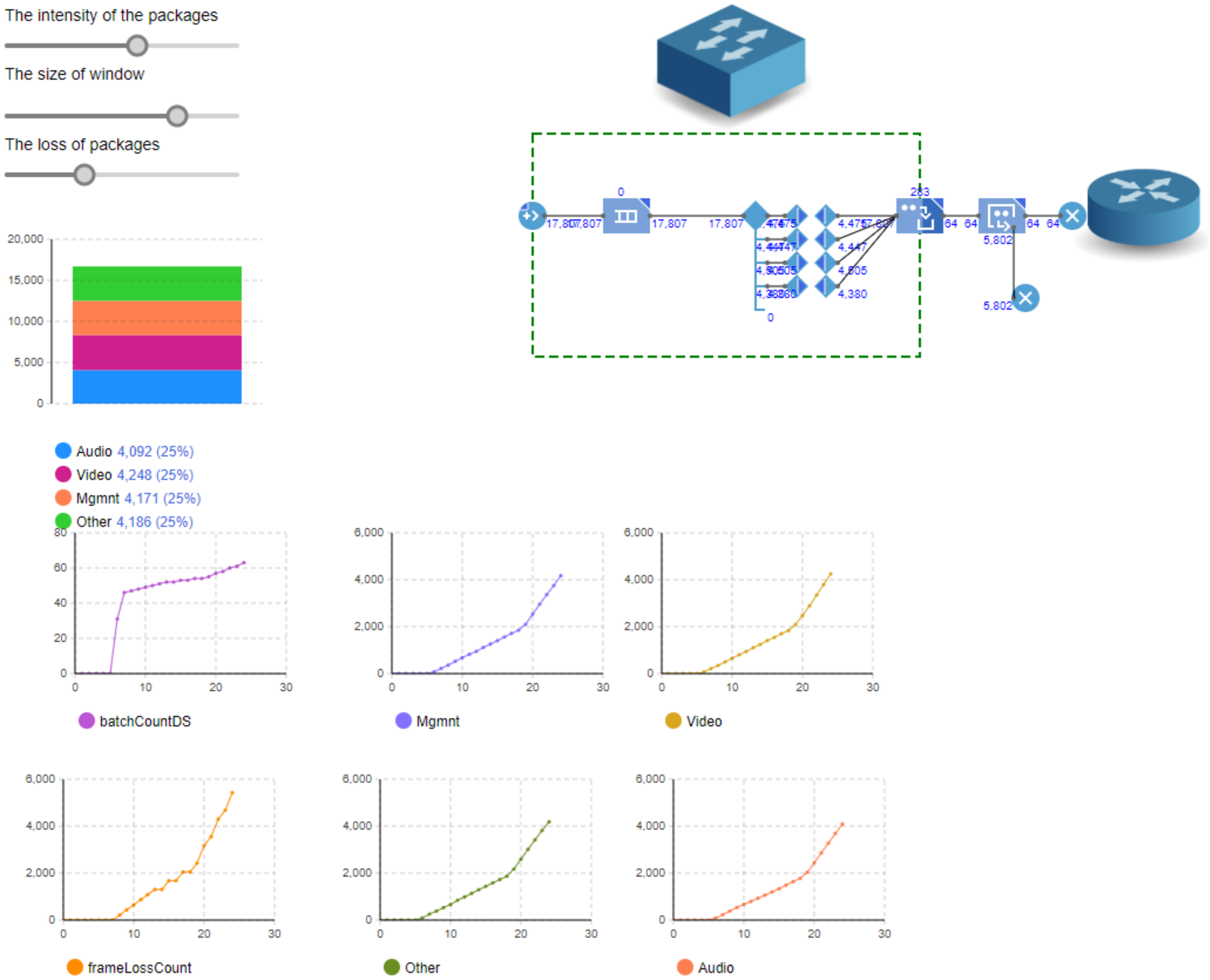

Figure 1. The result of program work

In this model was used the traffic received earlier from the virtual enterprise network created on the basis of EVE-NG system. This system belongs to the class of network emulation platform, which has been actively developing for the last 5-8 years.

They allow to create rather complex network topologies using models of telecommunication devices (routers, switches, firewalls, etc.) and to simulate their functioning in real time [5-6].

For this thesis, a data transfer network was developed, the L2 model of which is presented in figure 2.

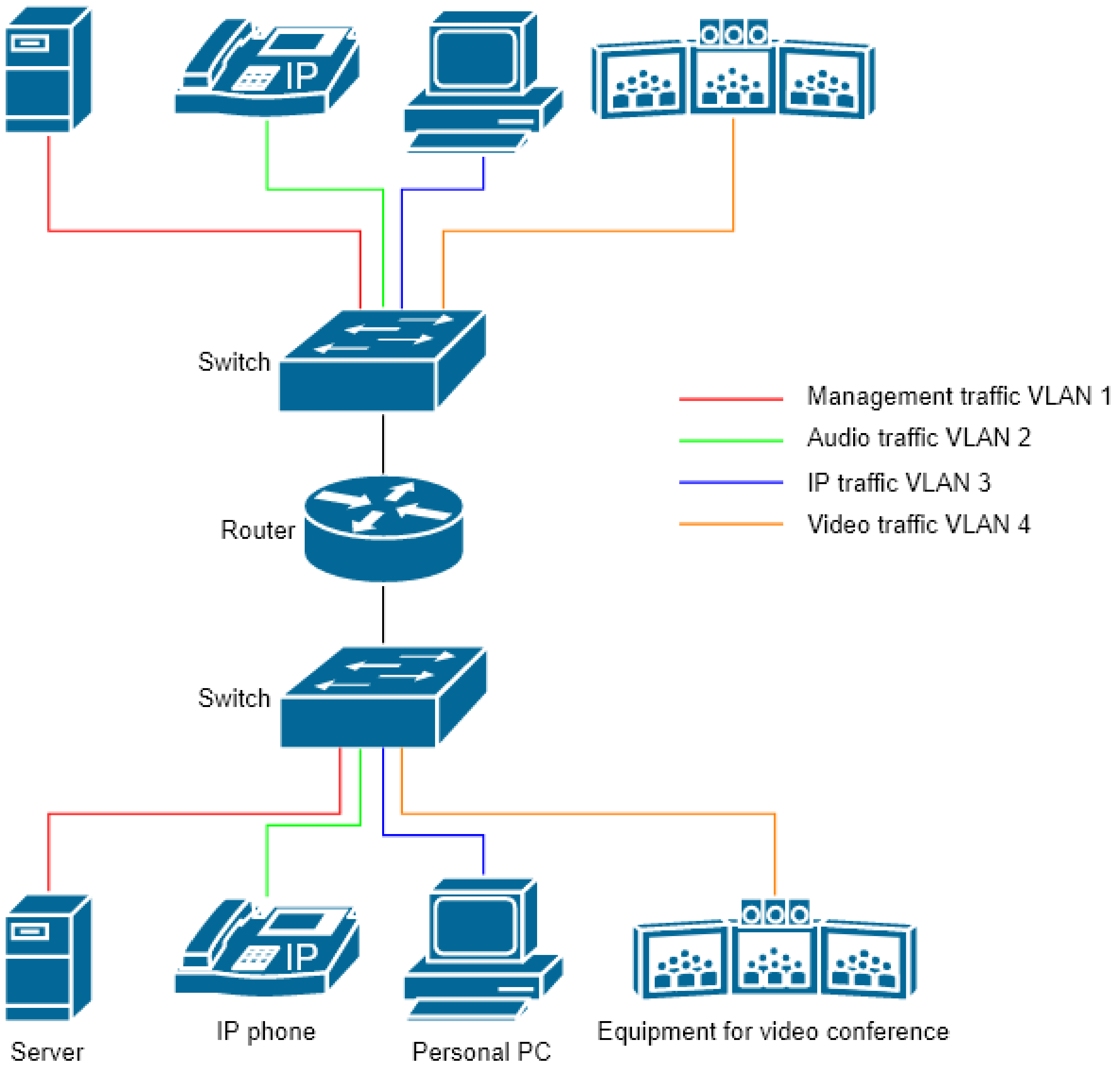

Figure 2 – L2 model of data transfer network with different types of traffic

As can be seen from the above scheme of the data network, there are manufacturers of various types of traffic including voice traffic, video conference traffic, server equipment management traffic and traffic that does not fall under other types. This network was reproduced in the EVE-NG simulation system. By simulating the operation of terminal devices, the quantity of frames of each type was measured. The obtained figures were filled in the CSV table. Later these figures were used in the simulation model to create a similar traffic flow. In the process of the simulation model, the calculations of bandwidth capacity and performance of the data link were carried out. The frame loss rate and its impact on traffic transmission success were also calculated.

3. Conclusion

During the development of the model, the need for high-load enterprise networks to control access to bandwidth was formed by prioritizing traffic by dividing it into four groups and allocating critical characteristics for different traffic classes. The simulation model of enterprise data network with multiservice traffic is developed. The calculations of bandwidth capacity and performance of data link are carried out. The frame loss index was also calculated. In the future, it is planned to add other prioritization options such as WFQ, WRED, CBWFQ, LLQ.

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