SIMULATING QUALITY OF SERVICES MODELS

Marek Huczala, Jan Kacalek

Telecommunication Department, Brno University of Technology, Purkynova 118, 612 00 Brno, Czech Republic, phone: +420 5 4114 9218, e-mail: marek.huczala@seznam.cz.

The purpose of the presented paper is to help to demonstrate Quality of Services (QoS) models. The paper introduces two most often used QoS models: Integrated Services and Differianted Services. The paper summarizes the pros and cons of implementing the models and covers their deployment in existing network infrastructure. The presented software simulations show the model behaviour in all the conceivable situations and outlines the interaction between the two QoS supporting systems.

Keywords: Networking, Simulation, QoS, Integrated Services, Differentiated Services.

1. INTRODUCTION

In the past, only two main types of network existed. The data or terminal networks were used for data communication whereas telephone signals were transferred through the telephone networks. The data networks introduced packet switching; telephone networks instead, used circuit switching for carrying voice data over the network. Because of the immense difference between the two worlds, no idea of a single network used for carrying both data and voice existed.

Over the recent years of development, however, the situation has dramatically changed. Today's networks are carrying more data in the form of bandwidth-intensive, real-time voice, video and data, which stretch network capability and resources. The fast growth of the Ethernet communication protocol was a further stimulation element in even larger integration of voice and data networks.

Most of today's network environments are based on TCP/IP layer suite. This technology fundamentally doesn't support any of the Quality of Services mechanisms and offers services of the type widely known as "Best Effort" instead. The effort of bringing in new elements that would lead to a better Quality of Service achievement in the network communication meets new requirements and issues that must be solved in order to have the whole system work properly.

We started looking for a convenient way how to present, the informational base we gained from the theory of QoS models. Finally, we decided to build several software simulations that would graphically demonstrate the behaviour of the described models. These simulations are to be used in computer and networking labs.

2. QUALITY OF SERVICES EVALUATION METHODS

The QoS evaluation plays an important part in the integrated network environments where QoS must be considered. It is often implemented within the QoS models such as Integrated Services (IntServ), Differiented Services (DiffServ), MPLS and SBM systems.

Unfortunately, the metrics such as packet loss and discard, delay and jitter are not reliable enough to describe the overall quality of end-to-end communication. This lead to the recent introduction of the rating factor (R-factor) evaluation. Unlike other QoS evaluation methods, the R-factor also considers users' suggestive perception factors.

The R-factor calculation has been built upon the E-model (G.107 specification) and it combines many parameters affecting the communication session, see (1). The R-factor conversion to MOS is also possible, but involves difficult mathemathic calculation. The usual range of the R-factor is from 50 to 94 accordingly to the quality of communication.

$$R = R_O - I_S - I_D - I_{E\text{-}EFF} + A \tag{1}$$

R_0 – coefficient signal/noise.
I_S – the sum of all the devaluations during the transfer.
I_D – factor indicating the delay and jitter devaluations.
$I_{E\text{-}EEF}$ – factor indicating packet loss and equipment devaluations.

3. Simulating Integrated Services Model

Two additional service classes are introduced in the Integrated Services (IntServ) model:

- Guaranteed service
- Control Load service

Guaranteed service class is intended for applications requiring a fixed delay whereas the control load service class serves as analogy to the TCP transport protocol. Integrated services model (IntServ) most of all techniques brings the data world closer to the world of telephone networks. In this model, the initialization process is required prior to the data transfer.

3.1 RSVP Protocol

RSVP is a resource reservation setup protocol designed for Integrated Services model. It is used by a host/application to request specific quality of service from the network for particular application data stream or flow. RSVP is also used by routers to deliver QoS requests to all nodes along the path of the flow and to establish and maintain the link state. As a result of the RSVP operations, network resources will be reserved in each node along the data path. RSVP can request resources in one direction only and is capable of operation on both IPv4 and IPv6. The protocol itself does not transport any application data and is rather used as a control mechanism running in the background.

Fig. 1 illustrates a newly built software application for demostrating the Integrated Services model. The application shows the model behaviour in many different situations. In this example, the computer Host1 is trying to send a message to the computer Host2. First the RSVP connection accross the network must be establish in order to provide a secured bandwidth managament. The application was built using Microsoft Macromedia platform. Both guaranteed and control load service options may be selected in the beginning of the simulation.

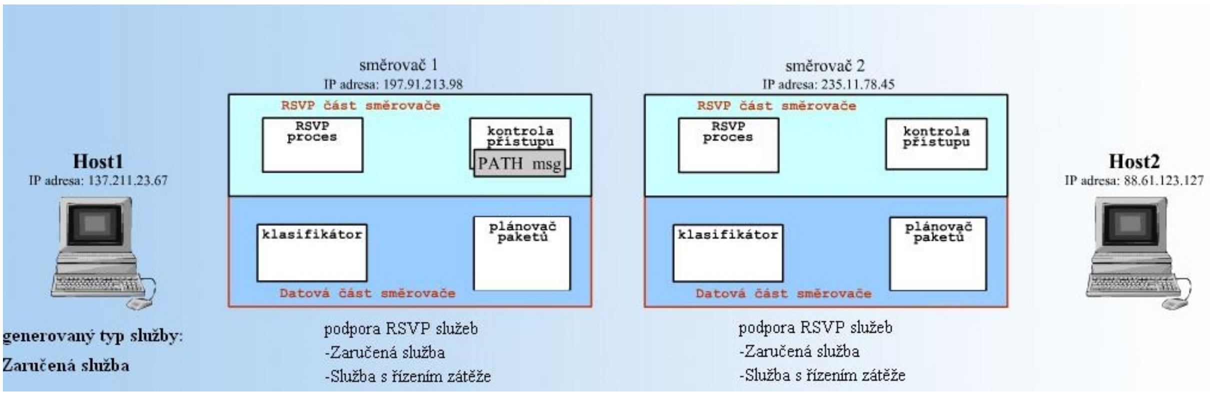

Fig. 1: Software application simulating the Integrated Services Quality of Services model.

4. SIMULATING DIFFERENTIATED SERVICES MODEL

The Differentiated Services (DiffServ) model uses information stated in the packet's IP header. Applications can then adjust the value of Type of Service field according to its requirements. The class of service is specified by its 6-bits DSCP code in the header of IP datagram. This QoS model defines the layout for Type of Service field and a basic set of rules for packet forwarding (Per-Hop Behavior, PHB). The packet forwarding rules cover priority control techniques, queue lengths supervision as well as the rules for packet discard.

Fig. 2 shows a new software application for demostrating the Differentiated Services model. The application outlines the model behaviour in all the possible situations. The application was built using Microsoft Macromedia platform.

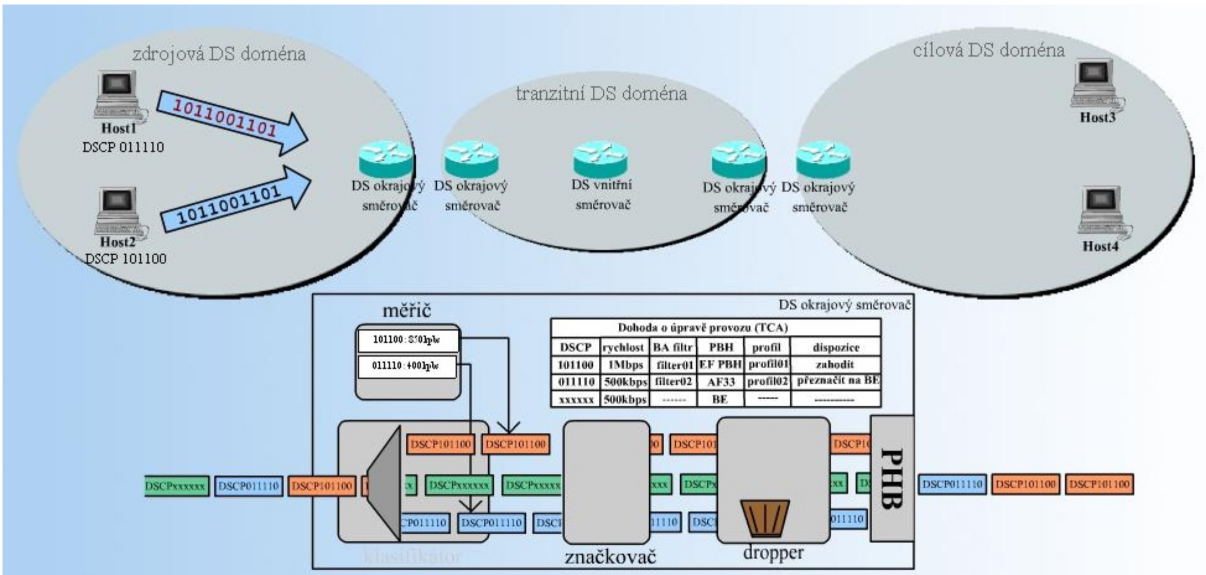

Fig. 2: Software application simulating the Differianted Services Quality of Services model.

5. Simulating QoS Models Interaction

The presented QoS models themselves may not ensure all the necesarry QoS parameters and the co-operation with one another or other QoS mechanisms and techniques is necessary. Fig. 3 illustrates a software simulation that demonstrates the co-operation between Integrated and Differentiated Services models. The simulation picture consists of three domains of dinstinct QoS policy. The message crossing the network needs to pass through all the domains to reach the destination Host2.

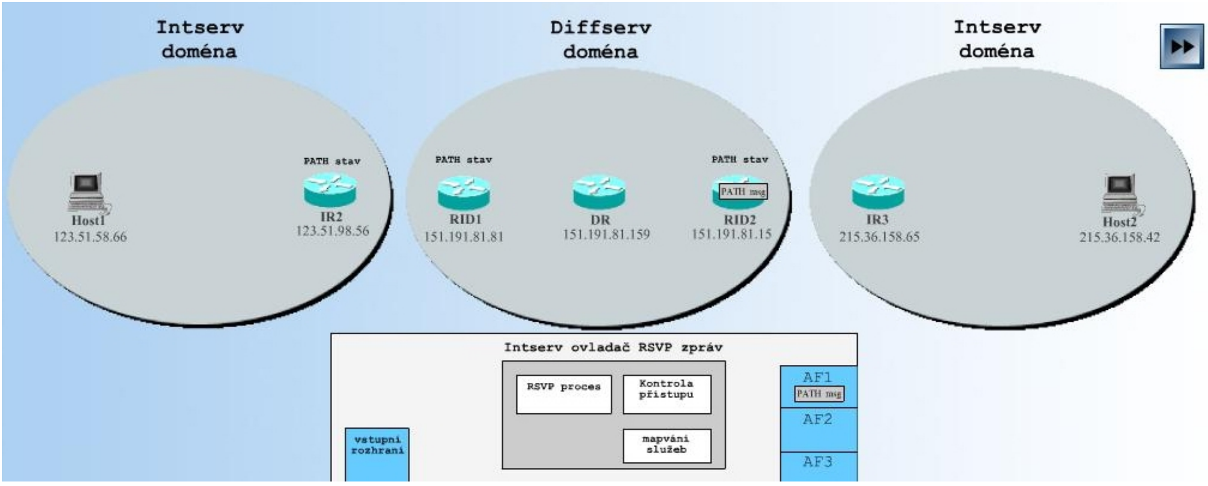

Fig. 3: Software application simulating the interaction of the Integrated and Differianted Services Quality of Services models.

6. Conclusions

Today's computer networks use the service type "Best Effort" to transfer data between end stations. "Best Effort" stands for the fastest way of trasmitting data but no guarantee mechanisms are being employed. The only way to adjust quality to a required level in communication sessions is through enlarging the network facilities. This lead to an introduction of new Quality of Services models that would help supporting a certain quality in communication relation among two or more network entities. Computer networks may today, with a help from QoS models and mechanisms, provide a required level of quality for data, voice or video traffic.

This paper presents simulation applications for demonstrating the theory of QoS models and their interaction. These simulations are supposed to be used for educational purposed in the computer and networking labs.

The information we gained from the QoS models theory also helped us define the interface between the two models.

7. References

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