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Chapter 9
Modeling of Packet Streaming Services in Information Communication Networks

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ABSTRACT

Application of the term video streaming in contemporary usage denotes compression techniques and data buffering, which can transmit video in real time over the network. There is currently a rapid growth and development of technologies using wireless broadband technology as a transport, which is a serious alternative to cellular communication systems. Adverse effect of the aggressive environment used in wireless networks transmission results in data packets undergoing serious distortions and often getting lost in transit. All existing research in this area investigate the known types of errors separately. At present there are no standard approaches to determining the effect of errors on transmission quality of services. Besides, the spate in popularity of multimedia applications has led to the need for optimization of bandwidth allocation and usage in telecommunication networks. Modern telecommunication networks should by their definition be able to maintain the quality of different applications with different Quality of Service (QoS) levels. QoS requirements are generally dependent on the parameters of network and application layers of the OSI model. At the application layer QoS depends on factors such as resolution, bit rate, frame rate, video type, audio codecs, and so on. At the network layer, distortions (such as delay, jitter, packet loss, etc.) are introduced.

INTRODUCTION

We present in this chapter simulation results of modeling video streaming over wireless broadband communications networks and the differences in spatial and time characteristics of the different subject groups during transmission over networks. Numerical results of the modeling and analysis of the effect of these parameters on quality of video streaming are presented and discussed. Also presented is the proposal of a completely new approach to modeling errors, based on a developed

Markov model with the use of actual statistics of errors in the channels of broadband wireless access networks. We show that discrete Markov processes with the necessary number of states describe the mechanism of transmission of video sufficiently well and an increase in the number of states of the Markov chain allows to observe less divergence between real and simulated data, but this increases the complexity of the model, analysis and processing of data. The chapter effectively summarizes the researches carried out to date by the authors in investigating the effects of video streaming errors on the performance of broadband wireless access networks.

In section 1, we present background information on the features of streaming services: their characteristics, quality parameters, and peculiarities of streaming H.264/AVC video over broadband wireless access networks. The second section presents the design and development of our streaming video software and its use in estimation of the quality of streamed video. In the third section of the chapter, we present our findings on investigating the effect of noise stability on the quality of streaming video. Each section of the chapter ends with a conclusion and relevant recommendations arising from the discussion of research findings.

1. PROPERTIES OF STREAMING SERVICES

1.1. Characteristics of Streaming Traffic and Quality Parameters Characterizing Continuity of Service

Streaming traffic–traffic type, which is characterized by viewing and (or) auditioning information as it becomes available to the user (terminal) equipment.

Traffic in modern computer networks can be divided into two large groups - *elastic traffic,* which

generates the traditional services such as email, WWW, FTP, and *real-time traffic,* which generates multimedia services such as IP-telephony or video conferencing. The share of real-time traffic is gradually increasing, due to growing interest in services, which allow for sound and high-quality video to be transmitted over computer networks (with high-speed bit stream and high resolution), such as the Music on Demand (MoD), Video on Demand (VoD) and IP-Television (IPTV).

Transmission of Streaming services (audio and video) over various media (wireless access, Internet, etc) is becoming more popular. This rapid expansion defines a new challenge of maintaining quality of service for each stream. On the other hand, new mobile systems are anticipated that will offer wireless services to a wide variety of portable terminals, ranging from cell phones and personal digital assistants (PDAs) to small portable computers. All these devices are heterogeneous.

They have different processing power, display, memory, and possible data rate. Thus, the rate of decoded data and content resolution need to be adapted to the surrounding network and display device (terminal). This quality is necessary to transfer huge amount of data on heterogeneous networks, and at the same time should find applications where the above-mentioned terminals are not able to display the full image resolution or all of the picture properties. Despite the shift to higher speeds, overload conditions often arise when trying to run resource-intensive services such as IPTV, available to multiple users. As a result, service quality is low, which is especially critical for video streaming - it should be noted that even minor disruptions to the picture on the screen or desync of audio and video tracks will cause a negative viewer reaction.

However, the problem lies not in slow network speed, but rather in the characteristics of the traffic, and more precisely in the peculiarities of the interaction between elastic traffic flows and real-time data.

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