

Chapter 6

TCP/IP Protocol–Based Model for Increasing the Efficiency of Data Transfer in Computer Networks

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ABSTRACT

This chapter provides solutions for increasing the efficiency of data transfer in modern computer network applications and computing network environments based on the TCP/IP protocol suite. In this work, an imitation model and simulation was used as the basic method in the research. A simulation model was developed for designing and analyzing the computer networks based on TCP/IP protocols suite which fully allows the exact features in realizing the protocols and their impact on increasing the efficiency of data transfer in local and corporate networks. The method of increasing efficiency in the performance of computer networks was offered, based on the TCP/IP protocols by perfection of the modes of data transfer in them. This allows an increased efficient usage of computer networks and network applications without additional expenditure on infrastructure of the network. Practically, the results obtained from this research enable significant increase in the performance efficiency of data transfer in the computer networks environment. An example is the “Donetsk National Technical University” network.

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INTRODUCTION

Intensive development of modern computer networks and programmable device systems realized from them resulted in the sharp increase of load and complexities (Network congestion) based on the stack of TCP/IP protocols. In turn, this results in substantial increase in workload in the operation of such networks. This process causes some difficulties on the hardware of a network, as well as the software applications. Thus, based on the background of intensive expansion of the global Internet infrastructure, both the magnitude of complexities and workload of corporate networks, grow substantially. Accordingly, the task of providing efficiency of the networks based on high-performance of the client-server and the distributed computing systems become more difficult. The only important reservation toward increasing the efficiency and productivity of such networks lies on improving the efficiency of data transfer within them. The Internet has pushed networking technology into the mainstream and it is without doubt the most important network, both in terms of technology advances and social impact, in the world. The number of host computers connected to the Internet continues to increase at an unceasing rate and shows no sign of slowing down (Lottor, 1992). This growth has placed strain on the network infrastructure that was built on what was, at the time ARPANET was created, experimental technology.

The Internet uses packet switching technology to transmit data, i.e. data that is to be transmitted over the Internet is split into small chunks, known as packets. These packets are then transmitted one at a time across the Internet where they are reassembled at the receiver.

The basic building blocks of the Internet are the protocols of TCP/IP suite (Petersen & Davie., 2000), which may be modeled as a stack of protocols split into several layers (Tanenbaum). The

underlying protocol at the network layer, Internet Protocol or IP is a connection-less best-effort protocol, meaning it has no established connection or authentication, and it does not provide a guarantee that the data sent will reach their destination (Petersen & Davie, 2000). Reliable delivery is provided by the Transmission Control Protocol, or TCP on which great emphasis will be laid in this chapter.

However, the properties that make the Internet so effective and successful also make it vulnerable to degradation in performance or “Internet Meltdown” or “congestion collapse” (Braden, 1998). Several aspects of the underlying Internet technology are showing their age and reaching the point where other approaches need to be explored if the growth rate and stability of the Internet is to be maintained. These areas include efficiency of data transmission over a network and congestion avoidance control (Nagle, 1984). The accurate operation of TCP/IP protocols brought about the fact that based on the knowledge of complex network projects and increased number of users on a network, noticeably the network traffic grows exponentially to a critical level. Well-founded selection mode of data exchange allows, in many cases, the reduction of workload on a network, increases effective bandwidth and performance efficiency of both network as a whole and separate network hardware-software and programmable systems. The problems related to increasing performance efficiency of computer networks, were looked into and published by many researchers, notably the works conducted at the National Technical Universities in Ukraine, the «Kiev polytechnical institute», the Institute of cybernetics, Ukraine National Academy of Sciences, the Kharkov National University of Radio Electronics and in many other universities of Ukraine. Also, notable are the works of Visheneskoro, Gorodetskovo, Zaborovskovo, Kamera, Menaske, Almeydy, Steven, and many others.

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