

Causes and Conditions of Occurrence of Congestion Situations in Telecommunication Networks

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ABSTRACT

This article discusses the main causes and conditions of occurrence of congestions situations in telecommunication networks.

Keywords

Telecommunication network, node, network traffic, intensity of traffic, transmission capacity.

1. INTRODUCTION

The congestion control is one of the important problems in development and operation of telecommunication network. The most advanced equipment and software very quickly become morally outdated and insufficient for processing of continuously increasing network traffic. Therefore, a special attention is paid to the improvement of the procedures for avoidance and elimination of congestion situations. The main subject of this article is the consideration of main causes of occurrence of congestion situations. The congestion situation is considered as a violation of condition of work in real-time environment.

2. THE MAIN TEXT

In conditions of intensive increasing in volume of telecommunication data traffic, the networks resources become insufficient for its processing. Because of this, there can be congestion situations and decreasing of quality of network services. The advanced technique and software of networks become morally outdated for a short time and cannot cope with increasing volume of traffic. The continuous upgrading of hardware and software of computer systems and increasing of network and computing resources are not so an easy task and it requires temporal and financial resources. Along with this, a special attention is paid to the enhancement of methods for development and organizing of operation of telecommunication networks. Among these tasks, improvement of procedures of load control, optimal distribution of computing and network resources, traffic management and congestions control are very important.

A real danger of emergence of congestion situations in telecommunication networks is directly put in network design process principles, when network resources are decided at the rate of average value of intensity of traffic with some stock. It means that at peak values of intensity of the entering traffic, the system can get to congestion situation. The congestion situations can also be because of the failures and malfunctions in communication channels and computing systems.

Many procedures are developed and introduced against congestions in telecommunication networks. However, despite of this, congestion situations frequently occur, because of which there are delays in transmission data and

decreasing of quality of service (QoS). Therefore, the problem of avoidance and processing of congestion situations is one of important problems of ensuring QoS in telecommunication networks.

3. DETERMINATION OF CONGESTION SITUATION

In scientific works on computer networks different definitions are given to the congestion situation [1-6]. We will consider some of them.

The congestion situation occurs when intensity of a network traffic, begins to approach admissible value. The problem of fight against congestion consists in maintaining intensity of receipt of packages lower than the level at which capacity begins to fall sharply [1].

When the number of packages transferred at the same time on network exceeds a certain threshold level, productivity of network begins to decrease. This situation is called overloading [2].

The congestion in computer networks is temporary exhaustion of hardware resources or bandwidth, in the result of which failures occur in network services or there is a collapse of network (the network ceases to perform its functions for transmission of useful information between nodes) [3].

The conditions for occurring of congestions in all these definitions are:

- the intensity of network traffic exceeds the permissible value;
- the network resources are exhausted;
- the network bandwidth is reduced.

The concept of congestions is tightly connected to the concept of the system loading capacity. When the values of current loading lower than the loading capacity of system, incoming traffic intensity is almost equal to intensity of originating traffic. In case, when the current loading value becomes above the system loading capacity, incoming packets are queued in the buffer file. The congestion situation occurs when the length of queue exceeds the threshold value.

The specified conditions of occurrence of congestion situations are insufficiently accurately formulated and there is a need for consideration. In system data transmission, the congestion situations are fixed on switching nodes. After it could spread to other nodes. Therefore, it is advisable to consider these issues for the switching nodes.

3.1. The intensity of network traffic exceeds limited values.

The concept of congestions is associated with the concept of the system operation in real-time environment, when there are time limits on applications processing. Lack of limits

time means, that the queue of applications can be endless. System can handle applications with any intensity and congestion situations cannot be fixed. Congestion situation should be defined mainly for real time traffic.

Of course, such formulation of question is purely theoretical. In practice, the queue of applications cannot be infinite, besides, any work has to be done for reasonable time. Otherwise, interest in this service will be decreased. In any case, the strategies of flows processing in network should be different for two types of traffic.

3.2. Exhaustion of network resources.

This condition characterizes the congestion situations more than the previous one, because this situation can also occur when intensity of a traffic is lower than admissible. However, it should be noted that this condition also not fully define congestion situations. Despite the sufficiency of resources, congestion situations can be arisen when transmission rate of the originating traffic is restricted from adjacent nodes.

This reason shall be considered in case of identification of causes of congestion situation and in the definition of proper procedures preventing and eliminating of congestion situations.

3.3. Network capacity reduction.

It is known, that the transmission capacity is defined as a maximum intensity of data traffic, which the node is able to transmit. The transmission capacity is usually considered as a constant value and some important estimates are made on the base of this. Such approach is not always justified. This parameter can change in the following situations:

- restrictions of transmission rate of flows from adjacent switching nodes lead to decreasing the intensity of transmission of the originating traffic and consequently to decreasing the transmission capacity of nodes;
- errors and malfunction of equipment lead to noticeable reduction in system performance and transmission capacity;
- errors and failures of communication channels lead to reduction of intensity of the originating traffic and transmission capacity of nodes.

As follows from the above-mentioned, the transmission capacity of nodes in principle should not be depended on intensity of the incoming traffic. In practice, such dependence can be explained because of imperfectness in procedures of detection and elimination of congestion situations both at the level of switching nodes, and at higher levels of the telecommunication network.

Generalizing the above mentioned, it can be offered the following definition for congestion situation: **The congestion is a situation, when the conditions of processing applications in real-time environment are violated.**

In accordance with this definition, in communication nodes, the flows of applications that have limit time on their processing can be causes of overload situations, the other flows, which have no limits should not affect the system load. Taking into account this idea, for the real-time flows separate queues can be created in the buffer file and congestion situations can be defined according to the level of overflow these queues.

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