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Traffic Management in Telecommunication Networks Using Artificial Intelligence

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Abstract: Traffic analysis and management tasks form the basis of modern telecommunication management processes. The goal of such solutions is to provide a balance between the volume of traffic, service and telecommunication resources. These tasks, as well as ensuring the effectiveness of technical solutions for a sufficiently long time, are carried out at the stage of designing telecommunications. In this article, a scientific research was conducted on the management of traffic in telecommunication networks using artificial intelligence methods.

Keywords: AI (artificial intelligence), traffic, telecommunications, resource, QoS, traffic generation.

Introduction

Artificial intelligence[1] which has firmly entered our lives and is now widely used to solve various problems. The tasks that artificial intelligence is reliable for solving include: recognition of text and images, finding the best (optimal) way to direct traffic, contextual advertising on the Internet, filtering spam, checking suspicious transactions on bank cards, and video surveillance security in systems.

Various problems are encountered in traffic analysis and management. These problems can be solved in different ways. The higher the quality of the solution, the higher the effective use of telecommunication resources and the quality of service. Solving these problems using classical methods does not always provide a sufficiently accurate and effective solution, which is related to possible inaccuracies due to the lack of specific methods and/or lack of information. These problems are solved with human participation, that is, with the operator's experience and intuition. Human participation is almost always necessary in decision-making in such a system. But in complex systems where there are many decisions to be made, a person can make mistakes for a variety of reasons, and as a result, a lot of hard work is created because of these mistakes. This leads to an increase in labor intensity and a decrease in system efficiency. Therefore, there is currently a growing interest in artificial intelligence (AI) methods (technologies).

In a number of cases, the methods of artificial intelligence allow to solve the problem, like a person, but at the same time they are devoid of such disadvantages as human fatigue and inattention. These methods, of course, cannot completely replace a person, but they allow to significantly increase the efficiency of work. There are many problems in the field of telecommunications. AI technologies can be used to solve them, including analysis and traffic management tasks.

Main Part

The topic of artificial intelligence in the telecommunications industry has appeared relatively recently in the world of scientific research, and it is also attracting more and more interest in business and production.

The term telecommunications traffic comes from the field of transportation, where it traditionally refers to the traffic of vehicles or pedestrians. Because there is a certain similarity between the processes that occur in communication networks and traffic processes, this term has gained a strong place in the field of telecommunications. There is no clear definition of this concept. Typically, traffic is understood as the process by which telecommunications networks receive certain events (for example, service requests or requests). Such events may be subscriber phone calls, subscriber service requests, sent messages, data packets,

1. Artificial intelligence or artificial intellect (English: Artificial intelligence; usually abbreviated as AI) is the consciousness shown by machines, as opposed to the natural consciousness shown by humans or animals.

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or data segments. The specific type of phenomenon depends on which network and at what level we are considering.

The purpose of the telecommunications network is to provide services, that is, to provide traffic services. The performance of the network is characterized by quality indicators of service provision [1-2], which are expressed in numbers and must meet certain criteria that may be different for different telecommunication services that are normative. In order to ensure or maintain a balance between quality indicators, traffic and the volume of telecommunication resources, telecommunication problems must be solved at the appropriate design and management stages. SI systems are generally defined as systems capable of performing creative functions that are considered human abilities. Traffic service is the goal of telecommunications activities, and performance indicators are indicators of quality of service (QoS) determined by traffic parameters and quality of work expressed by the volume of work performed. In the construction and operation of telecommunications, the problem of choosing an agreement between three main groups of parameters is solved: traffic, quality of service and amount of resources (*Fig. 1*).

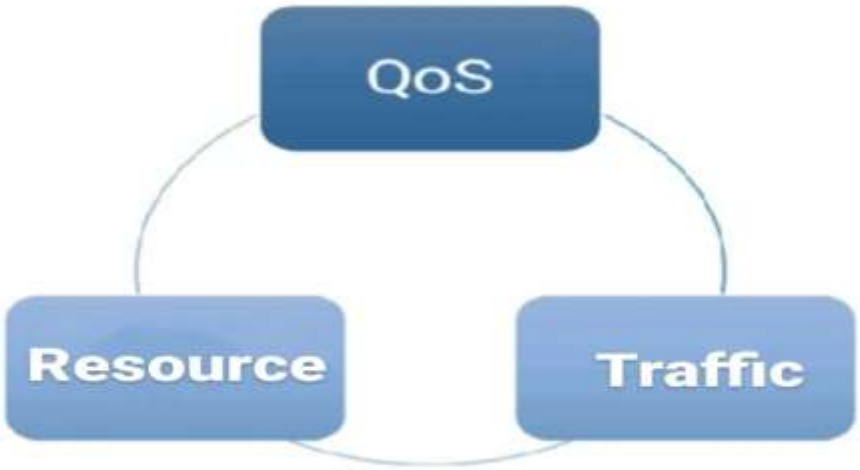

Figure 1. Quality, traffic and resource balance.

If we denote the traffic parameters by A = {a1,...,aka}, the quality of service by Q = {q1,...,qkq}, and the resources by V={v1,...,vkv}, in the general case the following expressions we can write:

$$Q = f(A,V)$$
$$V = g(A,Q)$$
$$A = h(Q,V)$$

Here f = {f1,…,fka} , g = {g1,…,gkg } and h = {h1,…,hkh} are some functional dependence groups for each of the parameters.

Tasks in the field of traffic analysis and management can be conditionally divided into three groups: traffic analysis tasks, traffic management tasks and traffic generation tasks.

Traffic generation tasks arise, for example, when testing equipment performance or telecommunications throughput. Traffic generation includes some technical implementations of devices that provide an artificial flow of applications, the characteristics of which can be changed depending on the task requirements. Traffic generation tasks can be solved both in full-scale models, that is, in the existing telecommunication network, and in the framework of simulation models in the form of software that simulates such a network.

Traffic analysis tasks include various statistical data collection and analysis tasks, while traffic management tasks include traffic restriction tasks to prevent network elements from being overloaded. The purpose of traffic analysis tasks can be expressed as follows: obtaining information about traffic. Traffic information may include:

1. Traffic model as a random flow;
2. Traffic model parameters and average traffic intensity.

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Tasks solved using AI technologies in the field of traffic analysis and management can be classified as follows:

- classification tasks;
- Regression tasks;
- clustering tasks;
- the task of determining the limiters.

An analyst [2] is often involved in solving such problems. When using SI technologies, these functions can be partially or completely transferred to the SI system.

Conclusion:

Considering the main tasks of traffic analysis and management in telecommunication networks and their solution approaches, we can summarize the level of feasibility of using AI systems. [3]

Table 1 summarizes the data and results of the expert evaluation of the application of AI systems within the relevant tasks.

Table 1.

The level of application of AI systems in solving problems

№	Issue:	SI application rate (0-5)
1	Traffic analysis	5
2	Traffic restriction	3
3	Traffic distribution	5
4	Traffic generation	4

In the table above, the score system for the application of the SI system to solve a specific set of problems is shown. According to expert evaluations, all considered tasks can be solved with the help of AI. At the same time, AI systems are largely used in traffic analysis and distribution tasks.

All research on the use of artificial intelligence technologies in the management of traffic in telecommunication networks is relevant today, and this relevance will remain for at least 10 years, that is, until the emergence of new telecommunication networks in 2030. The author of the article has no doubt that such research will continue even after 2030. Because even after this time, the scientific community will achieve new technologies in the field of telecommunication networks and the conscious use of artificial intelligence for them.

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