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ANALYSIS OF METHODS FOR DETERMINING THE QUALITY OF FUNCTIONING OF TELECOMMUNICATION SYSTEMS

Abstract. The rapid development and spread of information and communication technologies is taking on the character of a global information revolution today. Users have a need for communication services that can be flexibly configured. Next Generation Networks (NGN) - the modern stage of development of telecommunication networks (TCN) - represent a single transport platform on the basis of which various types of services are combined. One of the main aspects that should be taken into account when designing NGN is the provision of appropriate quality of service. With the introduction of multi-service networks, the approach to the task of service level based on the requirements of the users themselves for the quality of services becomes predominant, which requires the improvement of methods of managing the quality of services in TCN. The analysis of the works of domestic and foreign scientists regarding service quality management in TCN indicates the need to improve service quality management methods. It should be noted that in the works on the quality management of telecommunication services (TCS), attention is mainly paid to the technical indicators of the quality of services, while the development of effective methods of taking into account the user's opinion in managing the quality of services is currently relevant. The existing subjective methods of assessing the quality of TCS take into account the quality of the transmitted media information based on expert assessments, but do not provide a full assessment of the quality of the service by the user. The ITU-T recommendations describe different points of view on the quality of service, but do not provide specific methods for evaluating and managing the quality of TCS taking into account the opinion of the user. It is the unsolved task of comprehensive assessment of the quality of services in next-generation TCN that determined the purpose of this work.

Key words: network, service, internet, protocol, control, session, quality of service, user interface.

Introduction

Currently, global networks (Wide Area Networks, WAN) are used to provide information and communication services to a large number of end subscribers scattered over a large area - within a region, state, continent or the entire globe. Considering the long length of the communication channels, it is necessary to provide the necessary bandwidth of the channel, constant support in working condition of hardware and software nodes of the network, which are scattered over a large area. The main requirement for networks is to provide users with access to the resources of all computers connected to the network [1].

Research and analysis of the state and constant monitoring of telecommunication networks is an urgent task. Telecommunications monitoring is: observation, selection based on certain characteristics, processing and registration of a communication session in telecommunications networks using the telecommunications network monitoring system [1].

At the monitoring stage, the procedure for collecting primary data on the operation of the network is performed: statistics on the number of packets of various protocols circulating in the network, on the state of ports of hubs, switches and routers, etc.

According to the state of the primary parameters of the telecommunications network, the above-mentioned parameters of the network are determined. Let's call the current state of the telecommunications network the set of current parameters of the telecommunications network measured in a given time interval. Thus, under the monitoring of the telecommunications network we will understand the collection and recording of the current state of the telecommunications network in a given time interval. Let's call the normal state of the telecommunication network the set of parameters of the telecommunication network, which are established by the regulation of its operation in a given time interval.

Thus, under the analysis of the telecommunications network we will understand the process of comparing the current and normal states of the telecommunications network in a given time interval.

By the result of the analysis, we will understand the set of recorded values of discrepancies between the current and normal state of the telecommunications network for each parameter. The task of analysis requires more active human participation and the use of such complex tools as expert systems that accumulate the practical experience of many network specialists.

The received information about the operation of the telecommunications network can be analyzed with varying degrees of depth or detail.

Analysis of recent research and publications. The relevance of the study of this issue is confirmed by the analysis of the works of scientific workers and the opinions highlighted in these works in magazines, collections of reports of conferences held in our country and abroad. In this connection Khlaponin Y., Zhyrov G. investigate the problems of monitoring of telecommunication networks based on intelligent technologies [1]. In the research work Mozhaiev M., Peresichansky V., Roh V., Bellorin-Herrera O. consider method of analysis of quality indicators of computer network of information system of critical application [2]. Tykhvinsky V. pays attention to Management and quality of services in GPRS/UMTS [3]. Also, the focus of scientific research is the analysis of issues principles of architecture of intelligent networks [4]. A number of works by domestic and foreign scientists are devoted to the study of the ITU-T Recommendation [5].

Main part

One of the most urgent issues in the provision of communication services is the issue of service quality. A high level of quality is important both for the user and for the service provider, while it is important to guarantee the quality of the services provided, when the user has the opportunity to choose the level of service he needs, and the service provider undertakes to provide this level. Authors such as P. Ferguson, R. Huston addressed issues of service quality for all services supported by the NGN network. Regulation of heterogeneous traffic flows was considered by the following authors: Ya. Wang, S. Patek, E. Liebeherr.

Quality issues are considered in ITU-T recommendations [2]. Quality assessment in the next generation network is carried out at three levels: – at the user level, indicators of a person's subjective judgment are assessed, for example, a subjective assessment of the quality of perception of a particular type of information; – at the level of services, various aspects of service quality are evaluated, such as data transfer speed, coding mechanisms and much more; – at the transport level, the quality of network functioning is evaluated: delays, losses, delay variation, etc. In the work of Tykhvinsky a three-level quality assessment model and the corresponding assessment parameters are given (Fig. 1) [3].

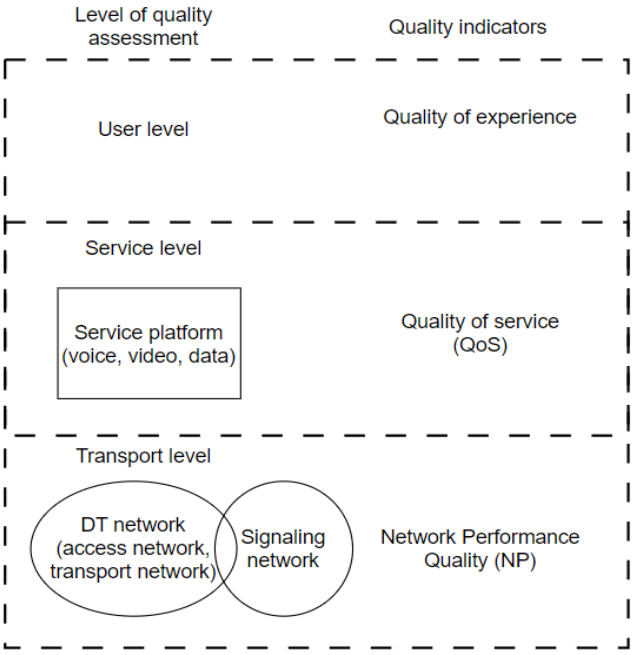

Fig. 1. Three-level quality assessment model

The MCE-T model is sufficient, covers all planes and network components of NGN. It not only includes ETSI TISPAN solutions, but also complements them. However, the works of MCE-T are of a general nature, so the use of this model in practice is complicated.

Therefore, it is necessary to improve the methods of managing the quality of services using ITU-T recommendations and to develop specific procedures for the implementation of the process of ensuring the quality of services in next-generation telecommunication networks, taking into account the opinions of users.

One of the main aspects that should be taken into account when designing NGN networks is ensuring the quality of service. The issue of ensuring the quality of communication services is relevant, and currently about 12 large international organizations are dealing with this issue, including: ITU-T, ETSI, 3GPP, DSL Forum, CableLab, etc. [4].

Quality of service (QoS) is a set of characteristics of a telecommunications service related to its ability to satisfy established and anticipated needs of the user regarding the service (the definition is borrowed from the ISO 8402 standard). For a comprehensive assessment of QoS, it is necessary to consider both the level of QoS planned and actually achieved by the service provider, and the subjective assessment of QoS by the user.

QoS management can be explained by applying four perspectives on QoS. These views cover all aspects of QoS - from the point of view of the provider and the user (or client) of the service. The four views of QoS are: customer QoS requirements; QoS offered by the operator (or planned / targeted QoS); QoS achieved (provided) by the operator; customer perception of QoS (QoS evaluations based on survey results). (Fig. 2) shows the relationship between the user's and the operator's points of view on the quality of services [5].

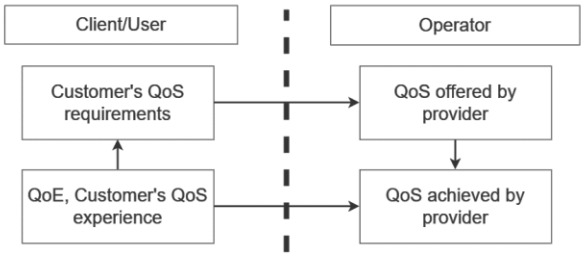

Fig. 2. Point of view on the quality of services

The quality of perception (Quality-of-experience, QoE) is the acceptability of the service or program as a whole, which is subjectively perceived by the end user. The quality of perception takes into account the influence of all aspects and participants of the service provision (user, terminal, network, etc.). The acceptability of the service may depend on the user's expectations.

Parameters affecting the quality of service perception:

– network efficiency ratio (NER);

– delay in providing the service;

– quality of provided media information (MOS / R-factor).

Customer's QoS requirements determine the level of service quality required by customers. The criteria and parameters that determined this level are reflected in the requirements. QoS offered by the operator (QoS offered by provider) is a list of clearly defined requirements that can be used: as a basis for forming SLA (Service Level Agreement); for the operator to declare the level of quality available to users; as a basis for planning and maintaining the service at a given level; as a basis for users when choosing an operator that provides the most acceptable level of service quality. QoS achieved by the operator (QoS achieved by provider) is the level of service quality actually provided by the operator. It can be used: by customers, the regulator as a basis for comparing the level of service quality offered by the operator and actually provided, and checking the fulfillment of the SLA; operator as a basis for corrections. QoS perceived by the client (QoE, Customer's QoS experience) is the quality of services perceived by the client and expressed in the form of an assessment. It is based on customer surveys and characterizes the customer's opinion regarding the quality of the services received. These data can be used for: comparison with the proposed level of service quality and determining the reasons for deviations; planning corrections. When determining the quality criteria of a telecommunications service, it is necessary to take into account these various views. (Fig. 3) shows the relationship between Quality of Service and Network Performance [5].

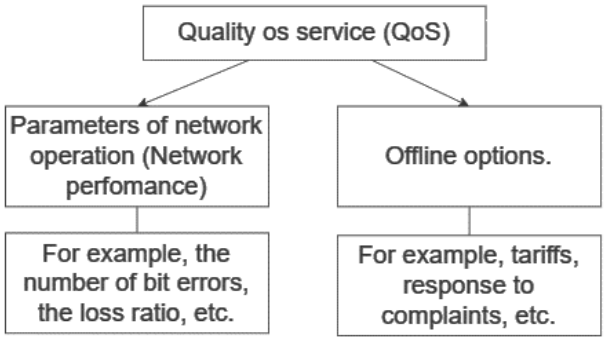

Fig. 3. Relationship between Quality of Service and Network Performance

Parameters of network performance (NP) - the network's ability to provide functionality that ensures user interaction: IPTD - information transmission delay, IPDV - delay deviation, IPLR - proportion of information loss, IPER - proportion of errors. Based on the analysis of the state of the issue, it can be concluded that MCE-T presented the most complete description of the concept of service quality, taking into account different points of view, but did not provide specific ways of calculating and forming a comprehensive assessment of service quality. Let's consider the developed methods of taking into account subjective quality indicators when forming a QoS assessment.

The rapid development and spread of communication technologies is taking on the character of a global information revolution today. Subscribers have a need for communication services that can be flexibly configured according to their requirements. This requires the development of evaluation methods and effective consideration of the user's opinion regarding the quality of services. Satisfying user requirements includes both technical (network performance parameters) and non-technical (user service) aspects. The analysis of scientific and technical literature shows that the development of telecommunication technologies exacerbates the problem of ensuring high quality of services, presenting ever-increasing demands on various aspects of their functioning. The urgency of improving and developing new methods of assessing the quality of telecommunication services is also due to the need to form a comprehensive assessment of the quality of services, which takes into account the contribution of all participants in the process of creating and providing the service. To date, various models have been developed for evaluating and managing the quality of services, which mainly take into account the technical indicators of the quality of the telecommunications network. To evaluate subjective indicators, MOS scores are used, which, however, also do not give a complete picture of service quality.

Despite the large number of works in the field of managing the quality of telecommunication services, the question of taking into account the opinion of users in managing the quality of services remains unresolved. When developing methods of managing the quality of services, it is rational to use a systematic approach: the problem of quality assurance should not be solved in isolation, but in the unity of relations with the environment - by the user. The existing methods of taking into account subjective quality indicators were analyzed and the methods of fuzzy logic and neural networks were chosen.

On the basis of the chosen methods, existing approaches and recommendations, it is necessary to develop a method of taking into account the opinion of users when managing the quality of services. At the same time, the contribution of various parties - participants in the process of creating and providing the service should be taken into account, and indicators should be grouped depending on which of the parties is responsible for their provision. The completeness of the assessment is ensured by the formation of a set of quality indicators, which should characterize the degree of satisfaction with all or most of the properties of the

services intended for the user. To select the quality indicators of a certain service, it is necessary to assess the impact of these indicators on the degree of user satisfaction with the quality of the service. At the same time, it is necessary to avoid the redundancy of the system - there should be no more than 4-6 indicators in each group. To assess the degree of user satisfaction with the quality of services, it is necessary to define sub-criteria that take into account the participation of all parties in the process of creating and providing services. When forming the degree of user satisfaction with the quality of services, the significance or "weight" of each of the quality indicators should be taken into account.

The possibility of forecasting network development needs should be considered based on a comparison of the current level of user satisfaction with the quality of services and the required value. To evaluate the effectiveness of the developed methods, simulation models should be developed.

QoS parameters are user-oriented and refer to the service as a whole, while network performance parameters may or may not be end-to-end. Although QoS parameters and network performance characteristics differ in essence and serve different purposes, it is clear that there is an internal relationship between them, some have a direct or indirect, and sometimes even inverse effect on the other. Based on the fact that QoS is a measure of "the degree of user satisfaction with the service", it is possible to assume that ideally subjective measurement methods should be used to determine the quality of service. However, subjective measurement is a complex and time-consuming process.

Objective measurements of network performance parameters can be used to identify and analyze specific QoS problems associated with network operation. The QoS measurement policy should take into account the parameters affecting the resulting quality of service between a number of aspects of the communication network architecture [1-5].

Thus, to obtain a complete picture of QoS, both methods should be considered - objective and subjective. Objective measurements are performed in case of determination of network performance parameters and other QoS parameters, which can be presented in quantitative form.

Subjective measurements are performed in the case of subjective aspects, and are also subjected to numerical expression of parameters, if the customer's perception of the quality that they think they receive is determined.

Conclusions

The principles of building telecommunication networks of the next generation have been studied. It is shown that the rapid development of information and communication technologies causes an expansion of the range of services provided.

On the basis of the conducted study of existing methods of taking into account the opinion of users regarding the quality of services in NGN, the necessity of developing methods that allow determining the level of quality of telecommunication services from the point of view of users is shown.

Based on the analysis of existing methods of evaluating and managing the quality of services in next-generation networks, the need to improve existing and develop new methods and approaches to managing the quality of telecommunication services, which must take into account both the technical characteristics of the network and the opinion of users regarding the quality of services, is shown.

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Аналіз методів визначення якості функціонування телекомунікаційних систем

А. Капітон, Р. Талибов, О. Дзюбан, Б. Канівець

Анотація. У статті розглядається принципи побудови телекомунікаційних мереж наступного покоління. Показано, що стрімкий розвиток інформаційно-комунікаційних технологій зумовлює розширення спектру послуг, що надаються. На основі проведеного дослідження існуючих методів врахування думки користувачів щодо якості послуг показано необхідність розробки методів, які дозволяють визначити рівень якості телекомунікаційних послуг з точки зору користувачів. На основі аналізу існуючих методів оцінки та управління якістю послуг у мережах нового покоління виявлено необхідність удосконалення існуючих та розробки нових методів і підходів до управління якістю телекомунікаційних послуг, які повинні враховувати як технічні характеристики мережі так і думку користувачів щодо якості послуг.

Ключові слова: мережа, послуга, інтернет, протокол, керування, сеанс, якість обслуговування.