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Since 2005

OCCURRENT SYSTEM OF ASSESSMENT OF QUALITY OF CORPORATE INFORMATION COMPUTING NETWORK

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Abstract: *The article analyzes the corporate network quality assessment. In the work questions of an estimation of qualitative indicators of corporate information-computed networks on the basis of neural networks are given. The main indicators are: information delay and packet loss. To evaluate the quality of the network, the use of a fuzzy model is proposed. A modeling algorithm for assessing the quality of a corporate information network is developed. The reliability of the proposed approach was verified with the help of a simulation system implemented with MatLab*

Key words: *class of service, quantitative evaluation, fuzzy information, fuzzy modeling, fuzzy logic inference system, expert evaluation*

Introduction: At present, many enterprises have their branches practically throughout the territory of our republic. In this regard, it becomes urgent to unite all existing resources in a single corporate network. Creation of our own corporate information and computer network (KIVS), which is a complex technical hardware and software system with a branched infrastructure and transport information transfer, is a challenge.

The solution of this problem is associated with attracting large amounts of financial resources. In addition, many real-time experiments are required to investigate the parameters of network performance. Therefore, at the present time mathematical modeling becomes more and more popular, which allows obtaining information about the behavior of the system or its individual subsystems, both at the stage of creation, odernization, and in the process of exploitation.

Formulation of the problem: It is necessary to develop a system for assessing and managing the quality of the projected CIVS of a particular enterprise. The enterprise has a distributed structure and it is necessary to improve the organization of communication and data transmission to its units by building a corporate network. At the present stage, the KIRS sets high demands on the availability of the network, its bandwidth and intelligence, that is, the ability to flexibly and qualitatively process traffic of various types (data, voice, video) that would provide high data transfer rates and a short signal delay time. It is necessary to find the best option in terms of the quality of functioning, which would ensure the circulation of data within certain parameters of quality throughout the network, regardless of its scale and protocols used. For this purpose, the following key parameters were identified that determine the quality of the CICA: availability of the network; throughput; delay; delay variation (jitter); packet loss.

Solution method: Network availability is estimated by the company's downtime per year: the less downtime, the higher the availability of the network. The downtime due to failure or deterioration of the network operation is reflected directly on the company's income. Bandwidth is one of the main parameters, as corporate networks are characterized by uneven traffic patterns, bursts and falls. Therefore, if the port has a small bandwidth, then at those times when traffic ishigh and the network is experiencing loads, the transmission quality will drop. The delay characterizes the interval between receiving and transmitting packets. The delay variation is a parameter describing possible deviations from the delay time in the transmission of packets. Packet losses occur when one or more packets with data transmitted over a network do not reach their destination.

To change these parameters, network services are sensitive to varying degrees. At times of congestion in the network, the parameters begin to deteriorate, and eventually all critical network services suffer. The implementation of the differentiated service traffic of network services (Quality of Service, abbreviated QoS), will ensure the functioning of critical services by limiting the traffic of less important network applications. However, in order to ensure the high-quality functioning of mission-critical applications in the corporate network, only the policies of differentiated services are not enough [1].

Therefore, to ensure the high-quality operation of the network, a set of technical measures is required to implement the network maintenance policy, as well as a monitoring and quality management system. A quality management system is understood as a configuration system that allows you to evaluate the quality and describe the network quality policy by defining the classes of service, parameters, norms and actions in case of their violation [2].

Taking into account the requirements and capabilities of the enterprise, a solution based on the IP VPN (Virtual Private Network) service based on MPLS (Multi Protocol Label Switching Multi-Protocol Label Switching) technology was chosen to build the network. The network will be able to operate any system that supports the IP-protocol, that is, the vast majority of existing applications. The advantages of MPLS technology include flexible definition of the network topology and the ability to assign different priority to traffic transmission depending on the tasks being solved [3].

The enterprise has classified the traffic of the CICC, and since some segments of the network are planned to be leased from the telecommunications operator, it agreed on the classification adopted with the service classes it supports, as follows:

•The first class of high priority service class corresponds to the traffic of video conferencing and a number of applications for which delays are critical;

•The second class of middle-priority service class corresponds to the telephony traffic and applications for which packet losses are critical;

•The third class of service with a low priority corresponds to normal business traffic, to which no special requirements are presented.

The process of functioning of the proposed system is presented in Figure 1.

The quality of the work considered by the CICC is characterized by a set of technical parameters that can be conditionally divided into the parameters of the quality of transportation of network services and the main parameters of the quality of the network. The quality of transportation of network services is determined by the following parameters: delay, delay variation, packet loss. The main quality parameters are: the availability of the network and its throughput.

As can be seen from the diagram, the evaluation of the generalized quality of the network is made on the basis of an assessment of the quality of the network services transportation K_t and the assessment of the basic quality of K_{bas}. To assess the quality of K_m, estimates of the qualities K_1, K_2, and K_3 are preliminary determined in different classes of service: first, second and third, respectively. In this case, K_1 is a function of the variables Z_i, BZ_i, nn_t, where the specified variables are respectively delay, delay variation, packet loss in the i th class, i = 1; 2; 3. K_{basis} function of the variables R (readiness) and TP (throughput). This approach allows us to treat quality as a function of independent variables, which in turn allows us to determine the quantitative quality assessment as the value of the "quality" function on a specific set of values of variables.

Figure 1. Structural diagram of the modeling algorithm of the system in blocks dotted out, the relationship between inputs and outputs is determined by a fuzzy rule base "If (...), then (...)."

Figure 2 shows a fuzzy model for assessing the main quality of the CICC. In the "Fazifications" block, the clear values of the variables Г and ПС are transformed into fuzzy sets, which are necessary for performing fuzzy inference. The "Fuzzy Rules Database" block contains information on the $K_{осн}$ = f **(**R**,** TP**)** in the form of nine linguistic rules "If (...), then (...)". In the "Defuzzification" block, the output fuzzy set is transformed into a clear number $K_{basis.}$ In the block-condition, a quantitative estimate of the permissible quality K_{add} with a calculated quality score K.

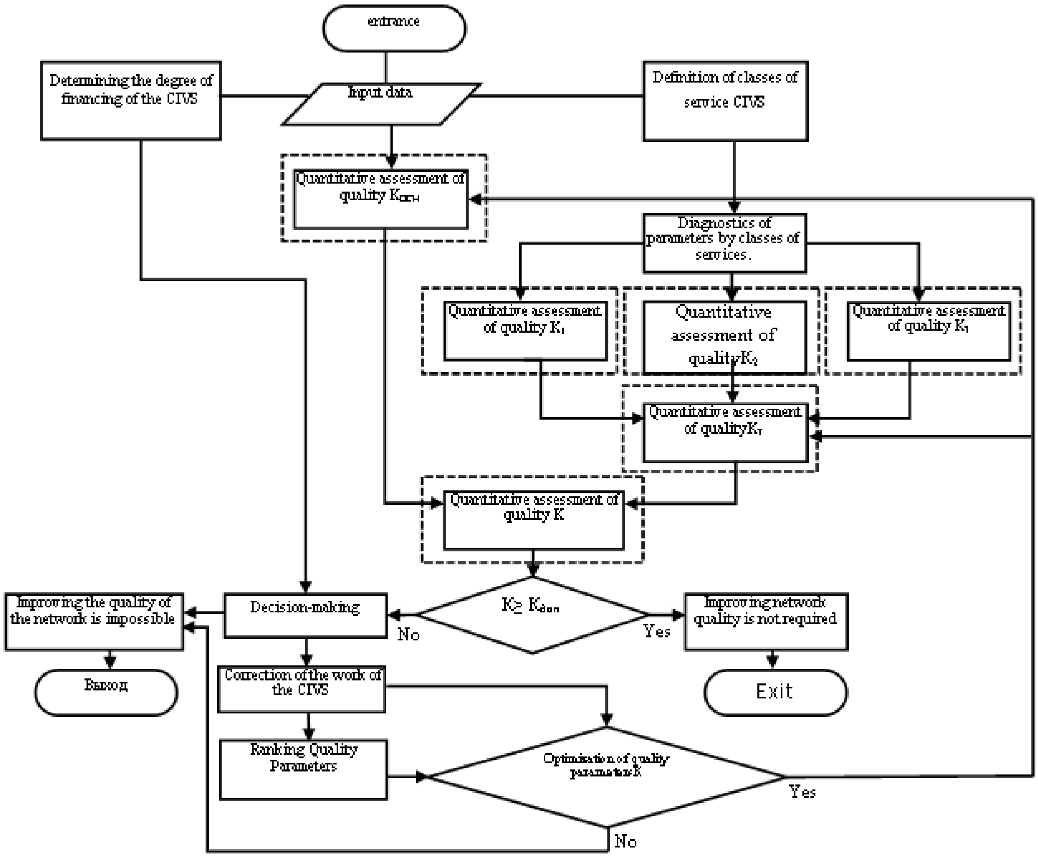

Figure 1. ***Structural diagram of the modeling algorithm of the system***

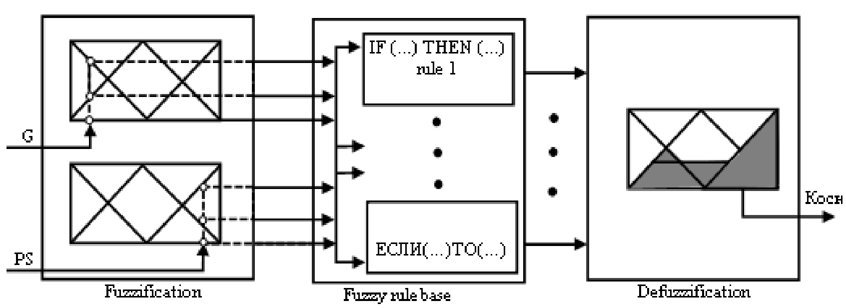

Figure 2. ***Fuzzy core quality assessment model***

The experts set the K_{add} = 0.77, taking into account the financial and technical capabilities of the enterprise, as well as the requirements of the customer.

Consider the task of assessing the quality of transportation of network services for a class of service with a high priority. To create a system of fuzzy output (START), we run the fuzzy module in Matlab. Adding input variables, we get the following structure of START: three inputs (delay, delay variation, packet loss), M_{data} fuzzy output mechanism, one output (quality K1). To each input and output variable we put in accordance a set of membership functions (MF) of the type *trimf*.

For a variable, a range of values from 0 to 80 (unit of millisecond), term sets (low, medium, high) and the corresponding values (0, 0, 18), (16, 30, 50), (40, 80, 80). For variable B31 the range of values is a segment from 0 to 60 (unit of measurement of millisecond), term-sets {low, medium, high} and corresponding values (0, 0,16), (12, 20, 50), (40, 60 , 60). For the variable ПП1 the range of values was chosen from 0 to 2 (unit of percentage), term sets {low, medium, high} and the corresponding values (0, 0, 0.25), (0.2, 0.5, 1), (0.9, 2 , 2). The values of the output variable K1 were defined in the range from 0 to 1 (unit of measure is a real number); Then, five FFs of the *trimf* type were added, the thermal sets {unacceptably low, low, medium, high, high} and the corresponding values (0, 0, 0.3), (0.25, 0.4, 0.5), (0.45, 0.5, 0.7) , (0.65, 0.75, 0.9), (0.9, 1, 1). As a knowledge base, 27 management rules were formulated. For illustration, we indicate only a few of them:

• If Z_1 is low and *BZ* is low and PP1 is low, then K1 is high.

• If Z_1 is low and *BZ* is average and PP1 is average, then K1 is above average.

• If Z_1 is average and B3 is average and B1 is average, then K1 is average. • If 31 is medium and B31 is high and PP1 is average, then K1 is low. • If 31 is high and B31 is high and PP1 is high, then K1 is unacceptably low. Using the output rule viewer, the input data values are entered, the fuzzy output process and the result are displayed.

Similarly, START was developed for assessing the qualities of K_2 and K_3. The obtained values of the K_1, K_2 and K_3 quality ratings were introduced as the values of the input data in the START to assess the QD quality.

To create the START for the assessment of the quality of K_{bas}, input variables were used: readiness: range of values [0; 1000] (unit of measurement minute), term sets {low, medium, high} and corresponding values (263, 1000, 1000), (25, 53, 526), (0, 0, 53); Bandwidth: range of values [64, 2048] (unit of measurement kbit / s), term sets {low, medium, high} and values (64, 64, 256), (256, 768, 1024), (786, 2048 , 2048).

The obtained values of the *QD* and K_{bas} quality estimates were introduced as the values of the input data in the START to estimate the generalized quality of *K*. The system for assessing the quality of the projected network based on information on the quality parameters, taking into account the service classes and using fuzzy modeling, was tested and showed the following results. Estimates of qualities for classes K1, K2, K3 and on their basis an estimation of the quality of CT of transport services of the network are determined.

With the input data (13, 13, 0.2), K1 = 0.848, which corresponds to an "above average" quality assessment for high-class traffic (sensitive to delay). With input data (11, 11, 0.18), K2 = 0.959, which corresponds to a high quality rating for mid-class traffic (sensitive to the packet loss parameter). With input data (14, 14, 0.22), K3 = 0.963, which corresponds to a high quality rating for traffic of low class of services. On the basis of the vector (K1, K2, K3) = (0.848, 0.959, 0.963), the estimation of the quality of transport services of the network for three classes of KT = 0.961 (high) was determined. The estimation of the quality of K_{bas} at the input data (25.1024) is equal to K_{bas} = 0.957 (high). Estimating the quality of the network K (0.961,0.957) = 0.965 (high).

The value of *K* = 0.965 obtained at testing is higher than the allowable value. This means that improving the quality of the network is not required, the customer is satisfied with this value of assessing the quality of the network.

Conclusion

Neural network technologies and, in particular, the capabilities of the interactive anfisedit module within the framework of the Fuzzy Logic Toolbox package also make it possible to simulate quality parameters and determine the dynamics of their changes in case of an increase in the number of input parameters. Adaptive neural-fuzzy ANFIS system automatically synthesizes from the experimental data a neuro-fuzzy network. In this case, the functions of belonging to synthesized systems are tuned so as to minimize deviations between the experimental data and the results of fuzzy modeling. Thus, it is possible to evaluate the quality of the CICS from experimental data of a simulation model or a real network.

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