

Optimization scheme of computer network reliability

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Abstract. With the rapid development of computer network technology, computer networks rise gradually, and penetrated into all aspects of the national economy. Whether it is political and economic or commercial, etc., each domain is inseparable from the computer network. Based on this, the application of computer network reliability optimization scheme was studied. In this paper, firstly, the computer network was briefly introduced, and then the application of computer network model planning in computer network processing was studied, finally, the optimization design of computer network reliability was carried out and the actual test was carried out. The results show that the reliability factors of computer network reliability analysis are more comprehensive, and the establishment of computer network reliability index system is more objective and realistic.

Key words. Computer network, reliability, optimization, network processing.

1. Introduction

The concept of computer network reliability was proposed in the 1970s. Due to the rapid development of communication technology, optical fiber technology and computer Internet technology, the function of network is becoming more and more important, and the research on the reliability of computer network is deepening. With the beginning of the process of social information, computer network users continue to increase, the computer network connection area and network connection scale also expands rapidly. As the computer network is widely used in business, banking, transportation, communications and other important areas, the computer network function is huge and the complexity of the structure is proportional. In view of this situation, in this paper, we study the optimization of computer network reliability. Computer network is an important foundation of research. So in this paper, firstly, computer network standards and types were studied, then programming model of computer network was analyzed, some results were obtained, finally, the computer network reliability optimization design was studied in detail, and the

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experiment was carried out. It is shown that the computer network link cost model and the computer network reliability model can meet the actual demand. It can accurately describe the state of the computer network and it has a good application prospect.

2. State of the art

In foreign countries, the earliest research on computer network reliability began with Professor Lee's research on telecom switching networks. The failure of computer network components greatly reduces the total transmission capacity of the telecommunication switching network, which causes call congestion, and the telecommunication exchange network area is significantly paralyzed. Professor Li defines call congestion as a link failure for a telecommunications switching network, and he first presents a reliability measure of a computer network based on connectivity [1]. In 1968, the world's first computer network Arpanet was born in the United States, which led to a lot of research on the reliability of computer networks. During this period, it is primarily a network connection. The connectivity of a computer network is required as a standard reliability requirement: As long as the computer network links, or as long as the communication between the computer network users need to connect, or computer network node failure, the computer network is in the process of work [2]. Wilkov, AHC, Baggal and other well-known scholars have given some connection based on the standard computer network reliability measures. Computer network reliability optimization design is firstly proposed by Boesch, which mainly involves the computer network reliability optimization and other issues about the improvement of the computer network topology. In the process of discussing these two problems, the calculation of the reliability of computer network is inseparable. On the calculation of computer network reliability, Satyanarayana, Baggal and other well-known scholars have given some specific algorithms [3]. After the 1980s, the rapid development of computer technology makes the computer network become an important component of the main communication channels and public life of industry, commerce, banking, telecommunications, postal service, transportation, energy, military, national security and so on. Under the background of the great development, the actual situation of the international computer network reliability index system and computer network is changing [4]. At present, the research on the reliability of computer network hardware has made great progress and it has gradually formed a relatively complete theoretical system. The research emphasis is gradually turning to the evaluation of the reliability of network management software and computer network reliability index system [5]. The research on the reliability of computer network in China is nearly 20 years later than that in the world. In addition, due to the ideological understanding, organization and management, manpower, material resources, financial resources and other factors, there are few researches on the reliability of computer network. The computer network reliability optimization design is a very popular research field at present. Therefore, it is feasible to study the relevant theories and techniques of computer network reliability, and it has theoretical and practical value.

3. Methodology

3.1. Introduction to computer networks

A computer network can be connected to each other through a communication link, an interactive device, and a related network protocol. It can perform complex network system specific functions, belongs to a number of different geographically distributed computers. The so-called independence indicates that any computer can not completely control the other computers in the network, they are independent of each other, and each computer is free to access the information resources that exist on the computer network [6]. Computer network is a kind of component in essence, which can provide mobile path for the communication between computers. The computer network can be composed of two parts: the user resource subnet and the communication subnet [7]. The subnet of the user resource can provide and process the relevant resource information to the computer network. The communication subnet can be responsible for the transmission of information in the computer network. The computer network itself has inherent structure and specific functions. The computer network is relatively large in the geographical distribution of the computer, and the computer network computer is independent of each other; The communication of computer network can be carried out through the network of communication facilities, and the communication facilities are composed of two parts, namely, the communication link and the switching equipment [8]. Computer network realizes information exchange and coordination through communication facilities. Interoperability is a higher level of requirement in computer network applications. It requires a command mechanism to support process interoperability between heterogeneous computer systems in an interconnected network environment while collaborating with application-related integration. Figure 1 is the actual operation of the computer network.



Fig. 1. Computer network

The computer network is generally composed of three parts. The first is the user device, which includes the user terminal, the server; the second part is the transmission of switching equipment, including communication lines and routers. The third

part is the network software, which consists of network management software and application software. Computer network is a structural framework of computer network, which represents the physical configuration of all kinds of hardware facilities in computer network. The structure of computer network is one of the most important factors that affect the reliability of computer network. Well-running computer network structure design should be carried out in accordance with the following five requirements, as seen in Table 1.

Table 1. Topological structure of computer network

Construction requirements	Computer network topology must meet the communication needs of all users to achieve the computer network planning, design, construction, operation of the expected objectives
	Computer network topology can adapt to the communication environment between buildings and buildings
	Computer network topology can facilitate the construction of computer network construction
Compatibility requirements	According to the actual requirements, the media can be selected to the appropriate computer network link
	With open planning, design benchmark, as far as possible with most manufacturers of network products and equipment compatible

The user terminal is a direct user oriented operating equipment, and its reliability is very important. It is one of the important factors of computer network reliability [9]. Routine maintenance during computer network operation is a reliable basis for ensuring that the user terminal is reliable. The higher the ability of user terminals, the better the network reliability, for example, the installation of two NIC connected to different LAN segments is more reliable. Server is the information hub and service provider of computer network [10]. It usually includes a database server, and a variety of application servers, including e-mail server, event server, Web server, and so on. These sub servers can directly affect the reliability of computer network operating efficiency. In general, the server's error resilience is associated with the response time and its reliability. While improving the reliability of each sub server, the server should be related to the dual switch system, when the server uses two servers, one as a host, and the other as a backup machine. Although this will increase the cost of the computer network, the corresponding computer network reliability is also improved.

3.2. Computer network model planning

The computer network topology is the problem of computer network planning, and it also affects the reliability of computer network. The practice shows that the different levels of computer networks must have different network topologies; otherwise it is impossible to improve the reliability of computer networks. The interconnection network topology is the main connection between components in the

computer network, which can be represented by Fig. 2, so graph theory is the most powerful mathematical tool to study the performance of the internet. First, people use diameter and connectivity to measure the effectiveness and fault tolerance of computer networks. With the deep research and analysis of computer network topology, computer network designers have proposed many new concepts of network and graphics theory, such as fault-tolerant diameter and width Diameter, limit connectivity, edge connectivity and fault tolerance. These parameters can measure the reliability and fault tolerance of computer networks more accurately. This provides a scientific basis for computer network planning and design. The following describes the impact of several commonly used computer network topologies on the computer network reliability.

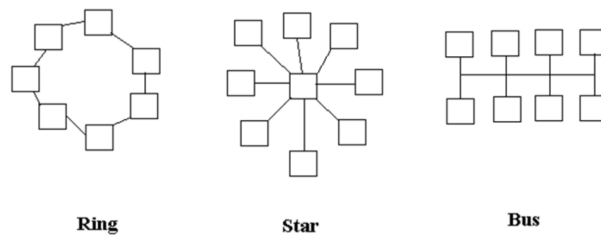


Fig. 2. Topological structures of computer networks

The bus topology itself is a link diagram of the network topology. The links between any two points in the link are unique, and they are often used for point-to-point networks or local area networks. Bus all nodes of the LAN are directly connected to the bus via a network card and are used as a general purpose transmission medium. The structure is simple, easy to implement and easy to expand. However, since all nodes in the computer network can only send or receive information through the bus transmission medium, Therefore, there may be two or more nodes using the bus to send information at the same time, leading to transmission conflict, resulting in transmission failure. The star topology of the network topology, most of the LAN systems which are based on the computer exchange center use the star topology network topology. Ring network structure is simple and easy to achieve the central node and then control the entire network communication. Any two nodes communicate through the central node. Therefore, it is easy to manage the computer network, any non-central node failure does not affect other node communication, but the network topology node is prone to failure. Pyramid network has excellent fault tolerance and effective performance, and it is applied by a lot of parallel computing, network computing, image processing, pattern recognition and intelligent systems and other network system. Various structures are shown in Fig. 2.

3.3. Optimal design of computer network reliability

Improving the fault tolerance of network system is the most effective way to improve the reliability of computer network. The general operation flow of fault-tolerant design of computer networks is to find the most common fault points by re-

dundancy and strengthen them, and the aim is to minimize the duration of computer network failure. In order to avoid data loss or problems caused by various faults, and even computer network failure, we must take a variety of redundancy measures to enhance the fault-tolerant ability of computer networks. In reality, many factors that affect the computer network's fault tolerance, including the degree of data link redundancy of the computer network components, how the computer network central hub equipment fault tolerance, how does the computer network backbone and the server be fault tolerant. Multilayer network architecture of computer network can most effectively use network layer service functions, such as network traffic segmentation, load sharing, and common network problems caused by fault recovery and incorrect configuration or equipment failure. In addition, the multi-layer network architecture of the computer network can also isolate the associated network faults well and support all frequently seen network protocols. The multi-level model of computer network makes it more convenient to transplant the computer network, for it preserves the various network addressing schemes, and has better compatibility with the previous computer networks. There are three layers of multilayer network structure in computer network. The multi-layer network structure of the computer network is shown in Fig. 3, which shows the design of the computer network.

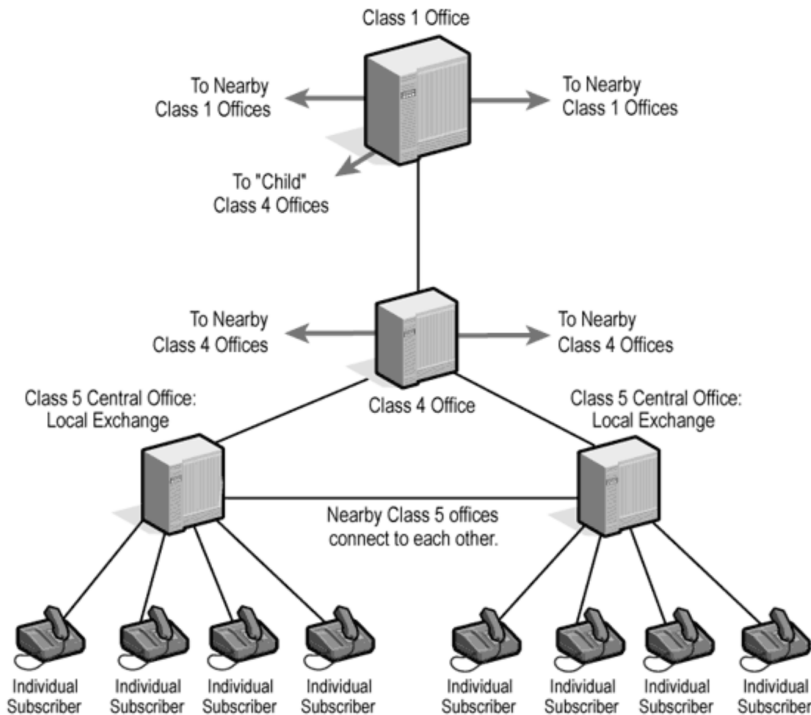


Fig. 3. Multi-layer network structure of computer network

In theory, improving the reliability of computer-related components and improving additional redundant components are the two main ways to improve the reliabil-

ity of computer networks. Under the premise of satisfying the expected function of the computer network, adopting the redundant technology (increasing the number of spare links) can improve the reliability of local fragmentation of the computer network; On the other hand, the construction cost of the computer network has also increased. The reliability matrix of the computer network link is as follows:

$$R_0 = \begin{bmatrix} r_{11} & \dots & r_{1n} \\ \dots & \dots & \dots \\ r_{m1} & \dots & r_{mn} \end{bmatrix} \quad (1)$$

Due to the low reliability and cost of each computer network link, the number of links in the computer network is small, so the reliability of computer network is high, which is in line with the actual demand.

4. Result analysis and discussion

In this paper, E1, E2, E3, E4, E5, five different computer network reliability index systems are evaluated. The training time of neural network learning algorithm is 600 times, the accuracy of neural network training error is $g = 0.030$, neural network input node $M = 5$ output node $n = 5$, the first layer neural network neuron threshold is $B = Ml2 = 2.5$, and the neuron threshold of the second layer neural network is 5.8. The reliability index and weight of computer network are shown in Table 2. In the table: the letter R indicates the user's complaint rate of the whole network service quality and the letter E indicates the failure rate of the computer network system software.

Table 2. Computer network reliability index system and its weight tab

Index	E_1	E_2	E_3	E_4	E_5	
R_1	0.022	0.024	0.018	0.068	0.084	0.10
R_2	0.013	0.018	0.019	0.017	0.024	0.10
R_3	0.965	0.995	0.896	0.963	0.936	0.20

In this paper, we use Matlab and its neural network toolbox function to write a specific neural network learning algorithm program, and use the program to train the neural network training samples for 600 times. When the precision of neural network training error is 0.03, the simulation curve is shown in Fig. 4.

The simulation results are shown in the figure, and the second layer output of the neural network evaluation model is 0.96, 0.97, 0.93, 0.67, and 0.92. The results of computer network reliability index system are as follows: E_4, E_2, E_1, E_3, E_5 .

5. Conclusion

The problem of computer network reliability optimization design is extremely difficult. Genetic algorithms such as genetic algorithms and neural networks provide

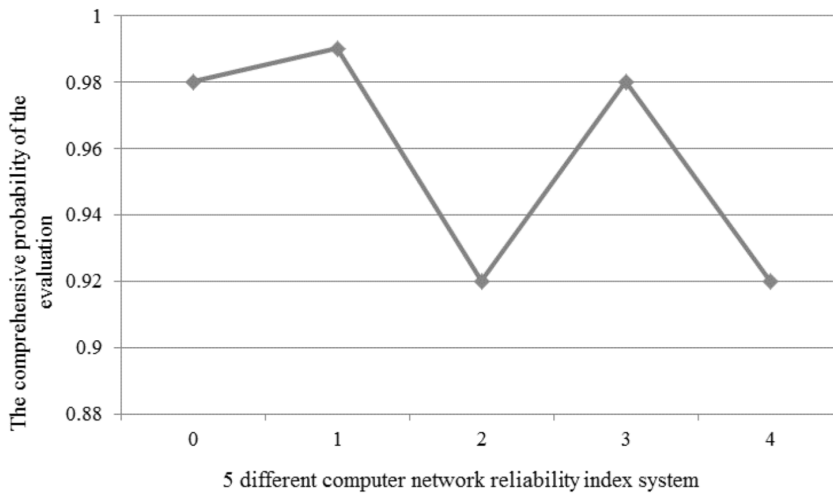


Fig. 4. Graph of reliability index system of computer network

a new way of thinking to solve these problems. Based on the analysis of the factors that affect the reliability of computer network, in this paper, the application of computer network reliability optimization scheme was studied, the computer network was briefly introduced, and then the application of computer network model planning in computer network processing was studied, finally, the reliability design of computer network was studied and the actual test was carried out. Neural network and other intelligent algorithms provide a new way of thinking to solve these problems. This paper solves the problem of computer network reliability optimization design, and provides some theoretical basis for computer network designers and constructors. The shortcomings of the thesis are mainly that the simulation program is running slowly, and the application of nested structure, recursive structure and Matlab neural network toolbox function is used in the program. This takes up a lot of memory and operation time. It is necessary to prepare a more effective simulation program in the future.

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