Model of Computer Network Topology Optimization Based on Pattern Recognition Technology

He Qi1

Abstract

The topological structure of the computer network has an important influence on the efficiency of the whole network system, the exertion of the technical performance, the reliability and the cost. The concept of computer network topology classification, introduces the characteristics, based on the analysis of the complex network structure, explore the effective construction of computer network topology model, for its practical application in the design of redundancy is studied, to improve the network system reliability and system safety design.

Keywords: Pattern recognition, computer, network topology, optimization model

Introduction

The topological structure of the computer network is the relationship between the line and the node which is composed of the computer, the network equipment and the transmission medium. The topological structure of the computer network is the physical structure of the network and the node which is composed of the computer or the network equipment and the transmission medium. Computer network node usually has two categories: one is the exchange and conversion of network information transfer node includes: terminal controller, hubs, switches and so on; the two is the main access node, terminal and computer etc.. The line is mainly refers to the transmission medium in the computer network, which has the tangible, but also the invisible, tangible called "wired", invisible called "wireless". According to the connection form of nodes and lines, the computer network topology is mainly divided into: bus, star, tree, ring, mesh, all interconnected topology.

The bus type is mainly made up of a high speed trunk cable, which is connected with a plurality of nodes. The main advantage of the network structure is that it is flexible, easy to construct, and has good performance. The disadvantage is that the bus will have an impact on the entire network, that is, the backbone bus will determine the fate of the entire network. A star network is a network composed of a central node hub and the surrounding nodes. This network communication must be realized by the central node. Star structure has the advantages of simple structure, flexible structure, easy to manage and so on. The disadvantage is that the central node has a heavy burden, and it is easy to form a "bottleneck" of the system. Tree topology is a hierarchical structure. In a tree structured network, there is no loop between any two nodes. The utility model has the advantages of convenient and flexible expansion, low cost and easy

1Haikou College of Economics, Haikou, Hainan, 571127 China
popularization, and is suitable for the hierarchical management system which is divided into primary and secondary grades. The ring topology is mainly through each node are connected to each other to form a closed circuit, the transmission of information is one-way, each node needs to install repeaters to receive, amplify and transmit signals. The utility model has the advantages of simple structure, easy construction, convenient management; its disadvantage is that when the node is excessive, will affect the transmission efficiency, is not conducive to the expansion of. Mesh type is mainly used in wide area network, because of the connection between nodes, so the network reliability is high. Because the structure is complex, the construction cost is higher.

This paper focuses on several commonly used network topology, in practice, the local area network often uses bus, star, tree structure. The topology of metropolitan area network and wide area network is very complex, mainly using the mesh or hybrid topology. The topology of the network directly affects the performance of the network, we should choose the appropriate network topology according to the characteristics of the network.

![Figure 1. Computer network topology.](image)

**The Proposed Methodology**

**Characteristics of computer network topology.** With the development of network technology, computer network topology is more and more complex. In recent years, the research of computer topology is more and more inclined to the power law distribution of the node degree. This kind of distribution has a certain degree of stability in different network topologies, that is to say, they have a power law distribution in the different scale of computer topology.

Computer network is a complex network, the optimization objective of communication network, in fact, minimizing the average distance between nodes, we minimize the number of edges in the network is the main target of topology optimization, which is the future trend of communication network is a small world network. However, the coverage of computer network is very large and global, and the development of its topology is also facing many technical problems. Therefore, it is not possible to realize the optimization goal of computer network topology. Although the development of the computer and realize the overall topology...
optimization design of the small world, it is not less, enough to show its characteristics such as high aggregation or has the characteristics of small scale optimization, these characteristics can produce showed some of its rules, namely the computer network with preferential attachment and growth mechanism. Growth is represented by the dynamic growth of the computer, so the computer's topology is also a dynamic process.

**Optimization model theory.** Optimization theory is one of the most commonly used methods of resource allocation and task scheduling problems in the academic field of computer system and computer network. The classification from the dimension of time, can be divided into static optimization and dynamic optimization of two kinds of optimization theory. The static optimization system as a time invariant system, maintain demand for resources and resources the system is considered as a time independent constant. However, the actual system often changes with time, and will be affected by various external random events. Static optimization model ignores the system changes in the future may also influence, decision makers can not reflect the current behavior in the future, cannot describe characteristics the system changes over time. Therefore, this paper focuses on the application of dynamic optimization theory in computer systems and computer networks. In the dynamic optimization theory, system as the objective function is the accumulation of income on the amount of time system. Compared with the static optimization theory, dynamic optimization theory can better characterize time-varying system with better reflect the influence of the current decision system of time cumulative objective function.

Dynamic optimization model is a hot topic in the research of resource allocation and task scheduling in computer system and computer network. It is very important to reduce the maintenance cost and improve the efficiency of the system.

Stochastic game nets model method is mainly applied to network security analysis, and model characteristics of stochastic game nets, it can be applied to model analysis with computer system using multiple independent decision makers involved, such as wireless networks, peer-to-peer (P2P) network and social network. Further research work will be aimed at these the characteristics of the application, research on modeling and analysis method for stochastic game nets, the expansion of the application of stochastic game nets.

**Pattern recognition.** Pattern recognition is defined differently in different literature. Generally, model is obtained through the observation with time and space distribution of information on specific things, the overall pattern in which categories or in the same class as a pattern, in which individual specific models are often referred to as samples. Pattern recognition is a technology that is used to assign the pattern to be recognized by computer.

According to the standard sample, pattern recognition can be divided into supervised identification method and unsupervised identification method. The supervised recognition method is to design the classifier under the condition that the training sample belongs to the category. Among them, feature selection and extraction is an important part of pattern recognition, if the selected feature can comprehensively reflect the essential character of the class, then the classifier is easier to design, otherwise, the classifier design difficulty is increased. Therefore, feature selection and extraction is an important part of pattern recognition.
Pattern recognition methods can be divided into 4 categories: statistical decision method, structural pattern recognition method, fuzzy pattern recognition method and artificial intelligence method. The method of artificial neural network pattern recognition is based on artificial intelligence. The first two methods developed earlier, and the theory is relatively mature. The latter two methods are applied more and more, because the fuzzy method is more logical, and the neural network method has the ability to solve the complex pattern recognition, so people pay more and more attention to it.

**Construction of computer network topology model.** After the fact that the node degree of computer network has the law of power law distribution, the construction of computer network topology model has a great change. The more we choose from the preferential attachment and growth of the law of the network topology of computer network topology modeling, which is mainly to make realistic computer model through the evolution of topological properties of some simple rules to automatically generate. The preferred connection process to a new node joining the network description is still relatively rough, because the new node first before joining the global information network, to understand and grasp with great difficulty, the second reason is a single priority connection is not to describe the complex part of the decision making process, but also easy to form a distributed node a small amount in the whole network. Therefore, it is necessary to consider a more perfect join rule to build a more realistic network model.

Now for the construction of the computer model is mainly based on the autonomous domain and router, but because the topological characteristics of computer network show some similarity, essentially at different levels and in different scale so to construct the topological model are applicable to the two grade. The main rule of this model is to develop a computer topology model, which is based on the growth and local preferential connection, which is like a hierarchical process.

![Figure 2. Construction of computer network topology model.](image)

This assumes that $n$ nodes distributed in a plane, and the existence of a discrete uniform around the clock, these nodes are aware of when entering the network, the node enters the network time distribution is random distribution started from zero to a specific time in specific. The action of each node before and after entering the network is to receive and send messages and respond to the received messages. Send and receive messages, including their own priorities and the scope of the message to convey, and so on. And the priority of these nodes will
have a direct impact on the range of message transmission, that is, the radiation radius. After receiving the message according to the message source node is often a priority to determine whether the node sends messages to connect many of the messages received by the source node if the existence of similar priority, it will randomly select a source node connection.

With the continuous advance of the time, the degree of node is increasing, the distance of each node can be reached more and more distant, that is, the formation of the connection will be greater.

Because of the variety of network topology, the structure of computer network is complex and changeable. In this system, the communication between the network service provider and the requester is carried out in a complex network. In order to solve the problem of complex network, it is necessary to set up a network protocol which accords with the computer network topology structure.

The main function of the computer network topology structure is to decompose the function of the network structure system effectively, and then to set up the function after the decomposition. This kind of network topology structure is a hierarchical structure, and its characteristic is that any layer is built on the basis of the previous layer.

Therefore, the core of the computer network topology architecture is how to divide the hierarchy reasonably, and to determine the specific function of each level and the interface between adjacent layers. Due to the emergence of a variety of local area networks, the need for different types of interconnection, in order to meet the needs of information exchange, resource sharing and distributed processing which requires the standardization of computer network architecture.

**Redundancy design and analysis of computer network architecture.** The redundant design of computer network architecture mainly refers to the link redundancy between nodes, that is, when a link breaks, it can communicate with other redundant links to ensure the security of the data. The redundancy design of network architecture is generally composed of two aspects: the core layer and the access layer.

![Figure 3. Redundant design of computer network architecture.](image)
Conclusion

In practice, in order to adapt to different requirements, the topology is not necessarily a single, often mixed with several structures. Because of the complexity of these structures, the computer network is very complex. In the process of constructing and forming the topology, the topological rules are: the growth of the nodes in the network. The node connected by the continuous growth and growth of the priority, so that the network topology to form a message of self-organization and transfer, and eventually developed into a network topology system, its core is a hierarchical structure, to communicate through the agreement, transfer of information. In addition, in the process of design, we should fully consider the redundancy design of the network to ensure the reliability and security of the network system.

Reference


