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Research on Computer Network Service Design Based on Optimization Theory

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Abstract: The optimization method provides a powerful theoretical support for the design of better computer network service quality assurance mechanism. Compared with the traditional heuristic network design method, the optimization method can find the optimal solution of the problem in theory, which can overcome the defect that the heuristic method cannot prove the quality of the scheme. Therefore, the mechanism design and performance evaluation based on optimization method has become a frontier research field in the field of network service quality. This paper systematically describes the quality of service of computer network and discusses the solution of model elements; optimization model of different structures corresponding; comparative analysis of the implementation of different optimization algorithms, finally summarizes the optimization scheme of computer network service quality. This paper studies the problem of task scheduling, resource allocation, system parameter configuration and deployment of network resources in the network.

Keywords: Quality of service; Optimization model; Resource allocation; Task scheduling

1. Introduction

The existing network protocol mechanism is a kind of heuristic design, the biggest problem of this design is the need to constantly use system patches for maintenance. This is due to the lack of theoretical support at the beginning of the design. At the same time, the biggest problem of the network protocol is that the cost of the follow-up maintenance is great, and the quality of service cannot be guaranteed. Therefore, it is necessary to optimize the existing network, and through the network modeling and analysis to achieve its best performance. At the same time, the optimization theory can provide the maximum theoretical support for network protocols. Once the problem optimization theory can be solved in time, thereby reducing the cost of network operations to the greatest extent.

2. Network Service Quality Optimization Model

2.1. Resource allocation model

Resource allocation is the primary problem of network resource allocation, which can greatly improve the efficiency of network resource utilization. Resource allocation is mainly aimed at the problem of network bandwidth allocation and queue space allocation.

2.2. Task scheduling model

The purpose of task scheduling is consistent with resource allocation. Reasonable task scheduling can effectively save network bandwidth, so as to optimize the allocation of resources. Therefore, there is no technical gap between task scheduling and resource allocation. Task scheduling can be divided into single task scheduling and multi task scheduling, and different scheduling methods are suitable for different networks, and serve different customer groups.

2.3. Deployment model of network resources

The purpose of network deployment is to maximize the integration of network resources and the existing network framework, and ensure the connectivity of the network operation and the best utilization of server clusters, etc.. Network resource allocation can be divided into the deployment of network hardware and network software deployment. The most important is the deployment of the server and firewall deployment.

2.4. System parameter configuration model

The configuration of the system parameters belongs to the optimization of the software system. The main contents are as follows: the configuration of the power consumption and the size of the congestion window. In a sense, the configuration of system parameters is the most important performer in the whole optimization model. If there is no reasonable parameter settings, then the performance of the network hardware cannot play a good role

3. Basic Elements of Network QoS Optimization Model

3.1. Optimization goal

Users are concerned about the objectives and network operators are concerned about the target is obviously different, but it does not mean that there is a completely irreconcilable differences between the two. Therefore, the optimization of network service quality is to find the common point, which is the so-called target optimization. The user's goal is to get the best service, and the operator's goal is to achieve more profit. Only allow operators to understand the quality of service is the guarantee of profit. Therefore, the goal is to optimize the operator is no longer from the simple interests, but from the quality of service, and ultimately to achieve an increase in efficiency.

3.2. Decision variable

The network situation is complex, so the specific resource scheduling should be based on the actual situation of the network. Therefore, it is necessary to increase the decision variables in the service quality model, which ensures the degree of freedom of network design.

3.3. Constraint condition

The resources available for scheduling on the network are not infinite. Therefore, some resources are essential elements to ensure the basic operation of the network, so it cannot be scheduled. Therefore, the network quality of service must be set up to prevent some of the constraints of the entire network into paralysis.

3.4. Fixed parameter

The setting of fixed parameters can effectively stabilize the network. At the same time, fixed parameters are used as the common parameters of network system, which can optimize the network and save the management cost to the greatest extent. Therefore, it is necessary to set the fixed parameters, and also need to be optimized.

4. Solving Algorithm of Network Optimization Model

4.1. Easy problems and polynomial time algorithm

Many optimization models can be formulated as convex optimization problems, such as linear programming, quadratic programming, and so on. Two. People found that determine whether a problem with convex properties, this to a certain extent determines whether is easy to find the optimal plan. For the convex optimization problem, the local optimal solution is the global optimal solution. There are many researches on the maximization of network utility, which is based on solving the convex optimization problem. The objective function is a convex function of the convex optimization model, and the constraint set is convex, and the equality constraint functions are affine functions. For maximizing the utility of the network, the objective function is a concave function.

4.2. NP- hard problem and approximation algorithm

Many optimization problems in the network are NP- hard, but it does not exist in the optimization algorithm in polynomial time. Zhang Ming's report presents a wireless Mesh network to ensure the perfect QoS challenge, which involves a lot of NP- hard problem. The "perfect" problem is difficult to solve, and it is difficult to expand. It also provides us with the motivation to compromise the time and effect for us. There are two steps to solve such problems: the specification of difficult problems and the approximation of difficult problems.

Many NP- hard problems can be expressed as integer linear programming problems. As a result, the primal dual method which is similar to the convex optimization problem is transformed into an approximate algorithm for the design of combinatorial optimization. Since the primal dual method is a general model, it becomes a general technique for designing approximation algorithms. Many other methods, such as greedy strategy, can be explained by the primal dual method. Figure 1 shows the problem and solution of NP- hard problem in network optimization.

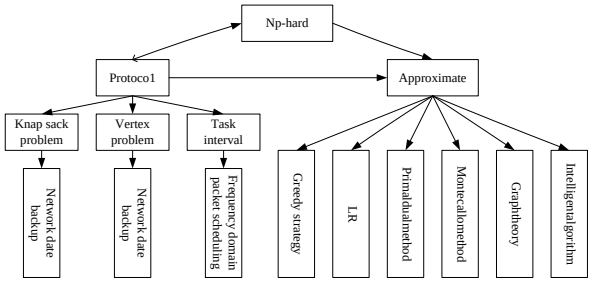

Figure 1. Network optimization NP hard problem of the classic problem and examples and the method of solving

5. Algorithm Evaluation

5.1. The cost of optimization algorithm

The upper bound of computational complexity can be given by the large O representation. In the optimization algorithm based on iterative method, the convergence speed of iteration is also expressed by this method. The primal dual interior point method has faster convergence speed than the linear one in solving convex optimization problems. For example, linear programming, convergence of interior point method for O(O(L)). Where L represents the binary encoding length of the input data; for SDP planning, convergence of interior point method under certain conditions is also O(VO(L)). This guarantees the polynomial time solvability of convex optimization problems. In evaluating the degree of network optimization algorithm, we should not only pay attention to the algorithm itself, but also consider the average performance of the algorithm. For example, at the beginning of the algorithm, the maximum throughput of the net-

work is obtained, and then the shortest route is selected. Using the shortest path method, and update the network capacity. The maximum flow of network complexity is added to each routing, which can be ignored. The principle of the algorithm is to pay attention to the cost of the service provided by the network.

5.2. Performance of optimization algorithm

In the optimization scheme, the optimization algorithm can get the best performance of the network. Such as the shortest path algorithm used in the network routing protocol, the optimal solution is obtained after the finite steps. However, numerical approximation for solving its optimal value by iterative algorithm in only when the need to artificially set theory and the optimal performance of tolerance. E is usually a very small constant, the size and number of iterations whose value is negatively correlated. So we need to take a compromise method E. In the NP problem, there is no scheme to converge to the optimal value in polynomial time. It is necessary to find approximate algorithm, so as to reach the compromise between performance and efficiency. It should be noted that, even in the presence of polynomial time solutions, it is possible.

6. Optimization scheme of computer network service quality

6.1. Centralized optimization and distributed optimization

The advantages and disadvantages of centralized optimization and distributed optimization algorithm are shown in table 1:

Table 1. Comparison of Centralized Optimization and Distributed Optimization

	Centralized optimization	Distributed optimization
Running speed	Slow (lots of tasks running on the same machine	Fast (parallel execution)
Inter node communication	Small (just controller interaction with each node)	Large (possible broadcast interaction)
Security	Weak (vulnerable to single point attacks)	Strong

The original decomposition method is based on a set of variables to solve the optimal value, and then update the gradient of the variables. The primal decomposition method and the dual decomposition method can be used in a nested way, which makes the process more hierarchical. Chiang et al discussed two kinds of thoughts contained in hierarchical optimization based on Decomposition: one is the network as an optimizer. Network protocols (such as TCP) are regarded as distributed optimization solutions. Although many of the network protocols are heuristic design, we can find the basic mathematical problems of the protocol by reverse engineering. The two is to optimize the network level design. Each layer of the network corresponds to a decomposed sub problem. The interface between layers is the communication information that is needed in the optimization iteration. By finding a low cost and less communication decomposition method, we can design a more reasonable hierarchical method.

6.2. Static optimization and dynamic optimization

The advantages and disadvantages of static optimization and dynamic optimization algorithm are shown in table 2:

Table 2. Comparison of Static Optimization and Dynamic Optimization Algorithm

	Static optimization	Dynamic optimization
The understand degree	Simple	Complex
Optimal conclusion	Strong (often able to find the optimal solution)	Weak (often converge to suboptimal solution)
Truth degree	low	High
Adaptability	Weak	Strong

Dynamic optimization can be based on the state based dynamic programming (or Markov decision process MDP), the basic elements are as follows:
Decision maker. A physical component or person to make decisions;
System state space and transition probability / intensity. The system state is a description of the current system state. Transferable relation between states;
The information set of decision makers when making decisions. According to the nature of information sets, MDP can be divided into two categories: one is the decision makers can get the complete information system, namely the ordinary MDP; two is the decision maker can only get part of the system information, this is called a partially observable Markov decision process (POMDP).

7 . Conclusions

Simply put, the quality of service is the functional level that the network provides to the application. Therefore, the quality of service is the total effect of service performance, and this effect determines a user's satisfaction with the service. Quality of service routing can be based on a variety of different metrics to select routing. It can meet the requirements of service quality and improve the utilization of network resources. At present, the quality of service routing algorithm is rare. The performance of the transmission protocol is directly related to the service quality of the network. Therefore a new transport proto-

col (such as SCTP) and the control protocol is proposed, at the same time as the link layer protocol has an important influence on the Internet and LAN access network quality of service, so the wireless local area network (WLAN) and wireless access network of IP QoS has attracted more attention. Overall, the development trend of computer network service quality optimization is as follows:

Pay more attention to the study of practical technology;

To strengthen the research of service quality management, and to make the service quality management combination of quality control;

Pay attention to the interaction of inter layer service quality technology;

Research on service quality technology focusing on application layer and network edge.

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