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Research on NAT Traversal in Campus Network Resource-Sharing System

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Abstract—With the growing number of Internet user nodes on the Internet, resources have tended to reveal a marginal distribution. In this case, if it continues to rely on traditional client/server (C/S) model of resource access architecture, the servers will meet challenges about costing huge investment of resources. However, using peer to peer (P2P) model and technology of NAT traversal can share resources between edge nodes, thus network bandwidth will be used more efficiently, and visualization of NAT subnet hidden nodes will be achieved. This paper is about development of campus network resource sharing system and its reliable test, which is based on the Visual C++ and the MySQL database platform.

Keywords- Peer network; Marginalization; Resource integration; Udp punching; Time synchronization

1. Introduction

Today, network nodes are continuously accessed to the Internet, the total number of resources are constantly increasing. Due to the marginalization of these resources were distributed mode, using the traditional C/S sharing model can not meet the growing demand for the resource service. However, using peer to peer network architecture model can solve the integration of these marginalized distribution of resources, it also can greatly improve the efficiency of resource sharing, and saves cost on resource servers. The key problem in Peer network model is how to pass through NAT (Network Address Translation) device successfully, established a session, and achieves visual communication between hidden nodes in the NAT device. Thus, it can realize peer network nodes interconnected and resource sharing. In this paper, we considered node distribution of a university campus network, based on NAT traversal study, and developed a resource sharing client/server software, which can achieve effective use of the existing campus network band and resource sharing between the edge nodes.

2. Peer Network NAT Traversal

2.1.Peer Network

Peer to peer (P2P) [1] [2] [3] is a network architecture concepts, has been already existed since the birth of the network in 70s of last century. It is got rid of the traditional C / S model, makes communication session adapt to the marginalization distribution of the network equipment, from the central to the network edge. This can effectively balance the network, avoid bandwidth overload of traditional center line and network congestion. Meanwhile, the network sessions tend to edge can be more efficient to find and share resources, which has brought great challenges to the traditional architecture of the internet.

2.2.Time Synchronization and integration binary search of port speculation technology

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Network Address Translation (NAT) device [4] has been widely used throughout the Internet in the case of IP resources have being scarce. It not only effectively implements the IP address reusing, ease the shortage of IP address, but also enhances security performance of the subnet through masking subnet visibility. As a result, it becomes a major obstacle for host communication in the subnets. For this property in NAT devices, the types of NAT device and traversal methods have been studied in our resource sharing system. Relative to the method based on STUN protocol [5] cross the Cone NAT device and needs to detect the cone at same time, we used time synchronization technical to assist crossing the Cone NAT, without determining the cone of Cone NAT in the current network topology. In time synchronization technology, system clock seeds (Clock-Seed) are generated and packaged by the secondary server, and then returned to the peer communication point. Cone Nat traversal devices are synchronized after the trigger of the seeds. Finally, for symmetric NAT device, we used integration binary search algorithm to optimist port speculation, and assist Symmetric NAT traversal through the technology, which provides some support for stable operation of the resources sharing system in this article.

2.3.NAT Classification

The application of NAT devices provides a way to solve the scarce of IP address, also build a secure internal network environment. However, because of NAT devices have been widely used, some difficulties have been brought to the realization of the P2P network architecture. According to the NAT port mapping principle, port is usually divided into four categories: Full Cone, Restricted Cone, Port Restricted Cone and Symmetric. In this paper, for the first three cones NAT, we classified as the same Cone NAT in this NAT traversal [6], because the assignments of port are follow a principle that any host within the subnet will be assigned the same port for all the out session. Although these three types of Cone NAT devices have different restrictions of session directions: full cone NAT device, the direction of the session is not strictly limited; restricted cone NAT session, it needs register destination IP before start out session; compared with Restricted Cone, Port Restricted Cone needs to register destination IP and ports at the same time. We introduce the time synchronization technology to solve the limitations of these different communications capabilities to the system. For Symmetric NAT, the port assigned by the destination IP and port changes, the directions of the session are strictly limited. Therefore, only by registering destination IP for out session and ports can its communications with internal mapping host be completed.

2.4.Time synchronization of Cone NAT traversal

In our resource-sharing system, there are two modes of network environment for the Cone NAT traversal: the first scenario is hidden one of the hosts behind a NAT device, while another host is in the public network; the second one is that two Hosts are hidden behind the NAT devices in different subnets. For the first case we can use reverse direction technology to cross, which is the basic technology for time synchronization traversal technology, see Figure 1; for the second case, we use time synchronization technology, which can increase the success rate of crossing, see Figure 2.

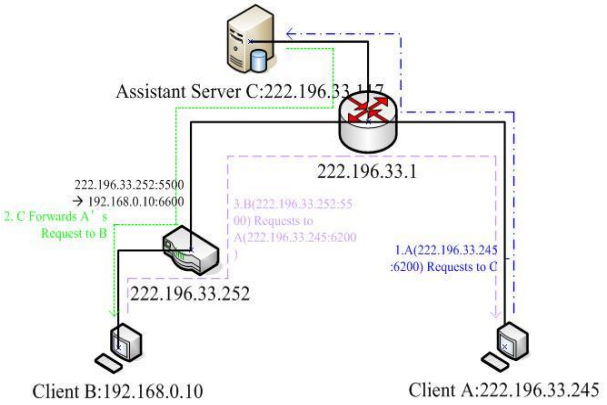

Figure 1. Reverse Connection

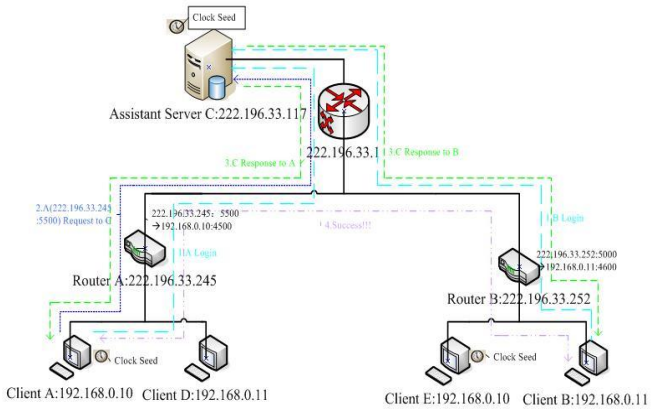

Figure 2. Time Synchronization

In the Model of Figure 1, at first client A and B have been successfully registered their login information to the secondary server respectively, including public and private IP and port. When the client A wants to establish a UDP session with client B, the client A will send a request to the server which will judge the

network environment of client A, B, if A is in the public Network, and B is in a private network, then sent request to the client B that establish a reverse connection with client A. When client B receives the request to establish a reverse connection, it will extract and analyze the relevant information of client A, and then send a request for establishing session connection to the client A's IP and port. When client A receiving the request information from client B, it means NAT traversal has been successfully achieved and cline B relative to client A has been visualized, also the session can be carried out.

In this process, the packets' source IP and port information send by client B will be the router into the router's public IP and a temporary port assigned for the Session, which acts as a communication bridge between the host A in the public network. When the packets from host A reaches the session port of the router, the router will find the host and forward the packet to the host B through search their own route table, which can ensure the entire session process successfully.

In the model of Figure 2, at first client A and B also need to register their login information to the secondary server respectively, When the client A wants to establish a session with client B, the client A will send a request to the server which will judge the network environment of client A, B, if A and B are in different private networks, then return Client B's public IP and port information to Client A, and sent request and Client A's public IP and port information to the client B. When server receives the establishing request information from Client A, it will produce a Clock-Seed of current time, and package Clock-Seed information to both responding packets. Once the Client A and B receive corresponding packets form sever, it will extract the information that will be used to establish the session. And then after the trigger of Clock-Seed, request information will be sent to out NAT device's mapping IP and port of both sides of the session at same time. Thus, both sides NAT devices register IP and port for the other side during converting out packets, which is like dig a hole for the other side's packets entering. The synchronized clock technique can be applicable for three different limited types of Cone NAT devices, which does not need to detect the specific type of Cone NAT device. With its high versatility, the successful rate of NAT traversal can be greatly improved. What's more it provides some supports for stable operation of the resources-sharing system.

2.5. Integrated Technology binary search through the Symmetric NAT port speculation

There is not an efficient method for the Symmetric NAT traversal at present. However, port-based method of speculation is widely used, which is based on the ports by a certain increment of the arithmetic sequence. This method can be used in the network which has enough bandwidth, and host visualization can be achieved. But, not all of the ports' number of Symmetric NAT is according to arithmetic sequence, so this traditional speculation method of port efficiency does not always show a clear advantage. In this paper, we propose a new port speculation method for the campus network resource-sharing system. Combining the advantage of arithmetic sequence speculation, we added binary search in it. Firstly, according to the arithmetic sequence method, we set a range of 500 to speculate, if the public port number of other side can not be found**,** we will use the binary search algorithm to speculate the area outside the scope of our pre-port speculation. This method not only improves efficiency of the arithmetic sequence speculation in a certain extent, but also improves the pure binary search (O(Log (2N))) efficiency, and ensures the reliability of the port speculation. The application of the improvement method provides an effective way for Symmetric NAT device traversal, which greatly improves the compatibility of the system's network environment, and ensures the system providing normal communication after transplanting in different environments.

3. System Experiment

In this system, combined with our Time synchronization Cone NAT traversal technology ensure the reliability of this type through the NAT device, and save the time cost in identifying the type of equipment by traditional based on STUN protocol [7] traversal technique. In the entire communication system, we use custom communication semantics, and move the data verification check work to the peer check module, which reduces network bandwidth utilization, compared with using protocols to verify the integrity of data. More over, it overcomes the shortage of verifying the data integrity by UDP protocol and is benefit transmission efficiency from using UDP protocol [8], which is suitable for our system's operating environment(campus network). Additionally, in the process of traversal, we set out verifying timeout mechanism to judge Symmetric NAT device. At this point, we will adopt the improved port speculation

methods to assist the system NAT traversal. In the end ensure the stable operation of the resource-sharing system. Functional process modules are shown in Figure 3.

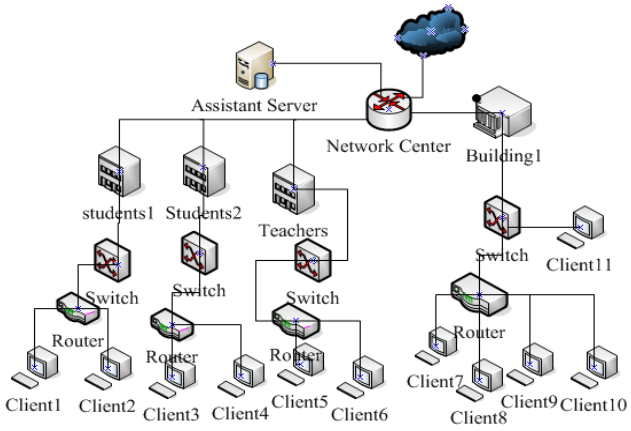

Figure 3. Functional Process Modules

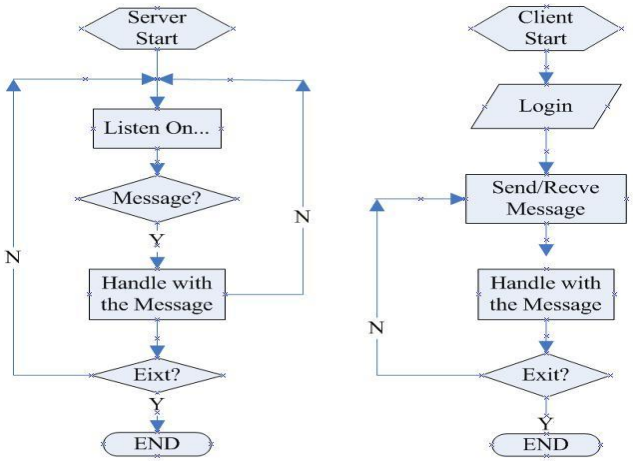

Figure 4. Network Topology

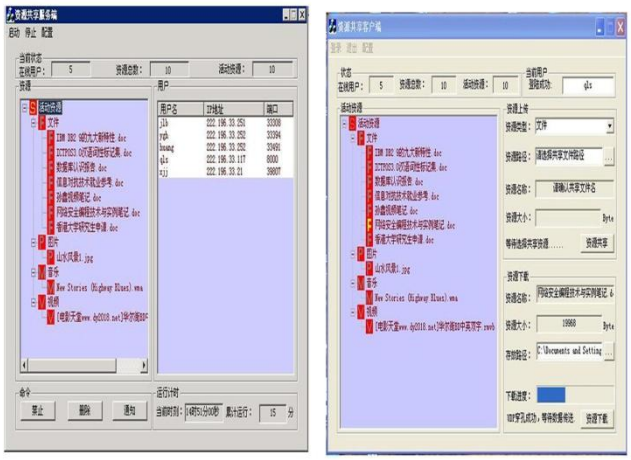

Figure 5. The Sharing of Resources System

For the network topology environment the system is running in, see in Figure 4, the clients running our resource-sharing system needs to register their login information to the secondary server at first, and then resource sharing can be started. For example, when the Client 11 in Building 1 wants share the resource of Client 6 in Teachers, then reserve connection technique will be used to cross the NAT device in the teachers' building, and resource sharing will be successfully completed; when the Client 1 in Students 1 wants share the resource of Client 4 in Students 2, time synchronization traversal will be used to cross the NAT device of both sides in most cases, if the type of device is Symmetric NAT device, then use the improved port speculation technology to cross NAT, and finally complete the sharing of resources. System operation is shown in Figure 5.

4. Conclusion

The original goal for the establishment of ARPANET [9] is to achieve software, hardware and data resource sharing, as the sustainable development of the Internet today, the sharing of resources is one of the main functions of network. However, due to the scarcity of the IP address and network security reasons, NAT device applications are joined. Widespread presence of NAT device in the network making the network formed in a peer environment of different nodes center, which brings a certain amount of disruption to the communication between hosts in different peer environment.

For the NAT devices are widely used, as a result, resource sharing barriers are existed in the current network environment. This paper adopts NAT traversal technique in resource-sharing system, achieves the visualization of hosts between different NAT device environments, ensures their normal communications channels. The successful establishment of peer nodes communication session can share resources with the

edge nodes in the network, which greatly reduces the dependency of traditional C / S server resource services, and makes static resources survive dynamically, so it can share resources in a wider area with the expansion of the peering node topology in the network, thus, the robustness of resource-sharing system is improved [10]. Looking ahead NAT traversal, it can be applied in broader areas, in addition to sharing resources, we can achieve large-scale distribution calculations [11], grid computing [12], unstructured P2P Zero limit search that based on the Small World theory [13], and so on. We propose a effective method to cross Cone NAT devices during the design of the time synchronization technique that adopted in the system, while for the communication obstruction of peer network caused by Symmetric NAT device has not an efficient method to complete traversal, it looks forward to further study and solution.

5. Acknowledgement

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