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The Research on Construction and Application Method of Virtual-Real Hybrid Network Environment

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Abstract*:* For some issues existed in the application of virtual network environment, the servers routing technology, GNS3 cloud connection technology and ICS Internet connection sharing technology have been skillfully adopted to solve connection problems on GNS3 virtual network and physical network, realize the interconnection between GNS3 virtual network and real operation network, and form virtual-real hybrid network environment. On this basic, network attack and defense and QoS test and other related simulation study with the environment have been carried out to indicate that virtual-real network environment has the realistic values on network talent training, actual operation training and network control strategy.

Keywords GNS3; Network project; Virtual-real hybrid network; ICS

INTRODUCTION

In the recent years, virtual network technique has been widely used on real network engineering design, network professional talents' training and some related fields. Packet Tracer network simulator was used to connect the pure virtual network that independent of real physical network in early times and now GNS3 network simulator[1] has been widely used to simulate network host and servers and form flexible virtual network environment[3] which can simulate real network topology through a variety of connection mode with Virtual BOX[2] or VMware virtual machine. More importantly, the virtual network can realize connecting with real physical network by cloud connection interface and form ability of single access physical network. That is to say, virtual intranet has the ability to visit physical outer net but without irreversible. The limitation can make that the real network traffic has no ability to access virtual inside network, the application of virtual network technology is still in the level of simulation that can't realize simulation for actual network.

The two-way connection issues of GNS3 virtual and physical network was solved masterly though main engine routing technology, Microsoft's ICS internet connection sharing technology and GNS cloud connection technique, the interconnection between virtual and physical network was realized that can make real network flow enter into virtual network and form the environment of virtual-real hybrid network. On the basic, the network attack and defense and network QoS test and some related imitation researches were applied by hybrid environment. The hybrid test environment is not restricted by network business, equipment and location that not only make actual flow access into virtual network, but also visit real network by operations of virtual network. It greatly increases the authenticity of virtual network operation. Moreover, it is flexible, convenient, economical and easy to use. It is also an ideal testing platform for real network engineer design and colleges network project professional practice teaching.

EMULATION SOFTWARE AND MAIN TECHNOLOGY

GNS3 and Cloud

GNS3 is a graphical interface network environment simulator that can run on Windows, Linux, MacOS and some related systems to integrate with Dynamips, Dynagen, Pemu, Winpcap, Wireshark and some components to provide network simulation ability that based on Cisco IOS. Users can upload ISO for real network equipment of Cisco companies to construct numerous complex network topologies conveniently and emulate real network environment and network configuration operation and that is the most common tools to study routing protocol and QoS policy. The simulated equipments by GNS3 are divided into routing equipment(that including C1700, C2600, C2691, C3600, C3700, C7200, AW+Router and Juniper router), switching equipment(mainly the second switches), terminal equipment(Qemu client, Virtual BOX client, host and Cloud) and safety equipment (PIX firewall, ASA firewall and IDS). Among these, cloud can simulate LAN NIO, NIO UDP, NIO TAP, NIO UNIX, NIO VDE, NIO NULL and various forms of head end

equipment that with numerous types of network pork to provide rich connectivity and Ethernet NIO can connect the physical network for real host.

Virtual Box and virtual servers

Virtual Box is a virtual utility software that cross-platform that called virtual machine manager which can run on the system of Windows，MacOS，Linux and Solaris to set and manage virtual machine system for different hardware and software can simulate PC hardware that based on x86 structures to provide the ability that use multiple operating system at the same time, which highlight characteristic are small, simple, easy to use and can apply on embedded systems, desktop system, data center deployment and even cloud computing environment. To analyze the requirements of setting up virtual network environment, Virtual Box machine manage has he better integration and network connectivity with GNS3 to provide NAT, Bridged Adapter, Internal, Host-only Adapter and numerous network connecting modes.

For the environment of virtual-real mixed network testing environment, it is a viable approach with the help of Virtual Box machine to set up FTP, WWW, DNS, DHCP and each kind of virtual network severs to provide emulation application oriented training and testing environment.

ICS and host routing technology

ICS is a no routing Internet connection sharing technology[4] that proposed by Microsoft which have the ability of sharing an existing outer network connection without routing to realize the purpose of visiting with multiple hosts at the same time. The host running ICS should have two net ports, one connect physical outer network, the other connect virtual intranet(that can logical interface Loop back) and set up the property of physical outer network ‘Internet connecting shares’ is ‘allowing other network users through this computer to connect to the Internet’. So the TCP /IP default argument values of virtual network interface is 192.168.137.1/24. At the same time, the exclusive requirement is that set the arguments of TCP/IP for other Internet host in subnet addresses of 192.168.137.0/24 to realize the purpose of visiting outer net for multiple hosts without routers at the same time.

The host routing technology adds or deletes routing information by route orders to let networked host have the technology of routing forwarding ability. For the research, according to the situation of established virtual network topology and division of sub-network, configure corresponding routing at the connected network hosts to realize the two-way access between virtual networks and outer net.

CONSTRUCTION OF HYBRID NETWORK

Virtual network topology

The structure of virtual network topology is totally depended on practical problems demand. The example adopts network topology with simulating testing network performances such as drawing 1, virtual network parts are consist on five routers and a server.

The five routers simulate real network edge router, convergence router, core router, server configuration web services, Ftp service and DNS services that access network by F0/0 from router C2691-2. For simulating long-distance transmission, normally adopt serial interface connection between routers. Each port assigns specific IP address according to the sub-network, the network routing is unified using OSPF routing case.

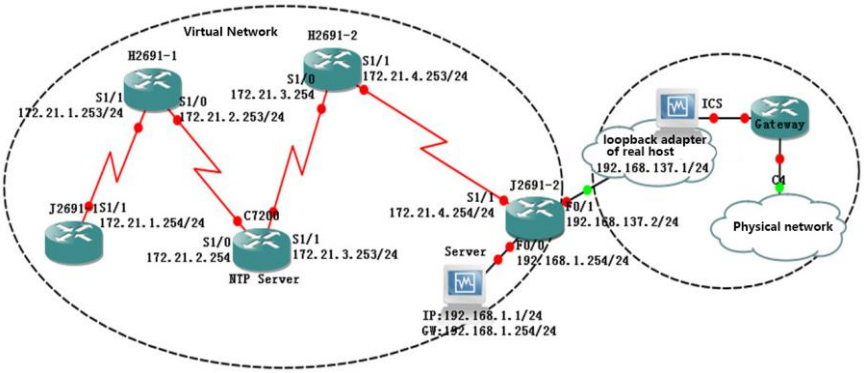

Figure1 Logical construction in virtual-real hybrid environment

Connecting between virtual and physical networks

GNS3 virtual network connect to physical network though cloud equipment connects and operates GNS3 real hosts. So it is necessary to add a cloud equipment to connect with physical net at the edge of virtual nets, as shown in figure 1. If there is only one physical port for real host(local connection), it will add Loop back adapter in the engine to produce another network interface(local connection 2) to connect with cloud equipment of virtual network. Start using ICS for the outer network connection of real host, set sharing property of local connection is ‘allowing other network users through this computer to connect to the

Internet'. Choosing local connection 2 is allowed connecting, win7 will set automatically IP address is 192.168.137.1/24. Setting local connection 2 with the rear host of LAN NIO in the cloud equipment of GNS3 virtual net to finish connection with virtual-real nets. Need to explain, in order to add real net to connect for cloud, it has got to operate GNS3 as administrator in win7 system.

MAIN CONFIGURATION OF HYBRID NETWORK

IP address assignment

The IP address assignment in each USB is shown as drawing 1. It needs to state that the routing connected with cloud equipment needs to located in the same sub-net with real host 'Local connection 2'.

Routing configuration

Virtual-real hybrid network is mainly includes from virtual network routings to physical network and their reversibility. The virtual network adopts OSPF routing protocol and each router must be collocated with the default routing information that up to physical network. The routing information returned virtual network are mainly deploy real hosts that covered each sub-net routing configuration for reaching into internal virtual network. The detailed information is shown in figure 2.

```
IPv4 Route List
===========================================================================
Active Route:
Dest-Network      network mask      Gateway          Interface      Metrics
 172.21.1.0       255.255.255.0     192.168.137.2    192.168.137.1     31
 172.21.2.0       255.255.255.0     192.168.137.2    192.168.137.1     31
 172.21.3.0       255.255.255.0     192.168.137.2    192.168.137.1     31
 172.21.4.0       255.255.255.0     192.168.137.2    192.168.137.1     31
 172.21.73.0      255.255.255.0      in the link     172.21.73.84     266
 172.21.73.84     255.255.255.255    in the link     172.21.73.84     266
 172.21.73.255    255.255.255.255    in the link     172.21.73.84     266
 192.168.1.0      255.255.255.0     192.168.137.2    192.168.137.1     31
 192.168.56.0     255.255.255.0      in the link     192.168.56.1     276
 192.168.56.1     255.255.255.255    in the link     192.168.56.1     276
 192.168.56.255   255.255.255.255    in the link     192.168.56.1     276
 192.168.137.0    255.255.255.0      in the link     192.168.137.1    286
 192.168.137.1    255.255.255.255    in the link     192.168.137.1    286
 192.168.137.255  255.255.255.255    in the link     192.168.137.1    286
===========================================================================
```

Figure2 Primary routing configuration for virtual-real network

Physical network access configuration

The above routing configuration only guarantee the virtual-real hybrid network can male interconnection in network layer, virtual Intranet can access physical net only by IP address. In order to visit physical net with domain names conveniently, it is necessary to use the two command configuration name 'ip domain-lookup' and 'ip name-server 192.168.137.1' to query in each router of virtual net GNS3. It has the ability to visit physical network by domain name in virtual intranet which covered ping www.baidu.com.

APPLICATION OF VIRTUAL-REAL HYBRID NETWORK

Adding related Internal sub-net or head end equipment in any place of virtual network inner that based on network environment of figure 1 and according to actual requirement of network experiment to have related network training and network control strategy validated with the hybrid testing network environment which faced to actual issues. One application of the research is have network attacking and defensing technology training and security policy that take use of virtual-real hybrid environment, add IDS equipment, IDS supervisor[5] and attacking host and drone[6] with actual demand. To manage IDS equipment and situation of monitoring network attacking by IDS supervisor. To install and deploy related attacking software in attacking host to have aggressive behavior to network. To simulate network faults on drone aircraft. Due to apply the virtual-real hybrid environment, the behavior of attacking host in simulative network (such as illegal scanning) not only be found by simulative IDS, but also produce warning information in actual IDS of physical network. The other important application is have network QoS testing technology[7] training and QoS control policy verification with virtual-real hybrid environment. There are real network parameters in the list 1 which tested in the environment of virtual-real hybrid.

Table.1 Test of real network parameters of virtual Intranet

Response time / Web	Minimum response (MS)	Average response (MS)	Maximum response (MS)
www.baidu.com	100	104	112
www.sohu.com	68	77	92
www.qq.com	68	70	76
www.edu.cn	60	67	72
www.zqu.edu.cn	100	110	120

CONCLUSION

Using the above method can build the environments of virtual-real hybrid network that can meet the requirement for each application to solve the issues of independent virtual network has no ability to access into real network flow skillfully to make virtual network technology have more practicability for network topology design, network protocol analysis, network attack and defense simulation, network performance test[8] and some related sides.

The three notable issues in specific application shall be noted, the first is that each sub-net IP address can't be able to locate in the same network with real host connection out net in GNS3 virtual Intranet, the second is that configuration for real host must access into routing of each sub-net for virtual Intranet GNS3, the third is that configuration of each touting must reach the default routing for outer net for virtual Intranet GNS3.

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