

Research and Implementation of Future Network Router

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Abstract—This paper summarizes the process and characteristics of IPV9, and introduces the digital domain name system, route management and security. The tunneling and dual protocol stack technologies are described. Both the transition from IPv4 to IPV9 and from IPV9 to IPv4 will be based on mature network conversion services that support protocol compatibility. The IPV9 router is currently available in two models, 100-megabit and gigabit. Both routers have good ability to meet the network needs of IPV9. The film transmission system of Beijing University of Posts and Telecommunications uses IPV9 and 5G technology, which is a relatively advanced transmission application of IPV9 at present. It summarizes the convenience and security brought by the new network address, and provides a new idea for the development of the network.

Keywords-Future Network; Router; Network Transformation

I. THE NEW NETWORK IPV9

Internet Protocol (IP) is a communication protocol designed for computers to communicate with each other in the network. IP provides a common rule for computers to access the Internet. The Internet has become the largest open network in the world. With the rapid development of the global economy, the advancement of communication technology and network technology, the penetration rate of computers

and mobile terminals is getting higher and higher. The problems with IPv4 are also exposed. For example, in the address space, performance, network security and routing bottlenecks, IPv4 makes it difficult to meet the needs of the Internet in the future. To solve the IPv4 many problems, IPv6, IPV9 and other Internet protocols have been born.

A. The Production of IPV9

The new network covers three new technologies: address coding design, new addressing mechanism and new address architecture design[1]. It aims to build a core technology system based on the underlying IP network. On this basis, a new framework can be formed. Connected and compatible with a network system that covers existing networks (Internet with IPv4 and IPv6 technologies). 2011 US government agency has the authority of the professional and technical confirmation from the law, my country has IP framework with the United States Internet network to the prior art, proprietary technology core network sovereignty. This is the patented technology of IPV9 (Method of using whole digital code to assign address for computer). The official patent name is “the method of allocating addresses to computers using full digital coding”.

The IPV9 protocol refers to the 0-9 Arabic digital network as the virtual IP address, and uses decimal as the text representation method, which is a convenient way to find online users[2]. In order to improve efficiency and facilitate end users, some of the addresses can be directly used for domain name. At the same time, it is also called "new generation security and reliable information integrated network protocol". It uses the classification and coding of the original computer network, cable radio and television network and telecommunication network.

B. The Characteristics of IPV9

By using IPV9 routers, clients, protocol conversion routers and other devices to build a pure IPV9 network, IPV9/IPv4 hybrid network to achieve a new generation of Internet systems with independent and secure intellectual property rights. Including the domestically controllable IPV9 future network root domain name system, promote technology convergence, service integration, data convergence, and achieve cross-level, cross-regional, cross-system, cross-department, cross-business collaborative management and services. With the data concentration and sharing as the way, we will build a national integrated national big data center, accelerate the promotion of domestically-controlled independent control alternative plans, and build a safe and controllable information technology system.

In the existing TCP/IP protocol, conventional packet switching cannot support true real-time applications and circuit switching, and supports applications such as transmitting sound or images in circuits in a four-layer protocol. With the demand for voice, image and data triple play, the incompatibility of human-machine interface and the environmental protection requirements for redundant links, especially the original security mechanism is unreasonable, it is imperative to establish a new network theory foundation. So in 2001, China established the Decimal Network Standard Working Group to study and implement security-based first-come-authentication

communication rules, address encryption, as short as 16 bits up to 2048 bits of address space, resource reservation, virtual real circuit The communication network transmission mode, such as character direct addressing and three-layer four-layer hybrid network architecture.

The existing TCP/IP protocol is a unreliable packet protocol with a maximum packet length of 1514 bytes. The TCP/IP/M protocol of IPV9, which is led by China, not only inherits the unreliable packet protocol of the existing TCP/IP protocol, but also develops absolute code stream and long stream code[3]. The data packet can reach tens of megabytes or more. After three can be transmitted directly by telephone and cable television data link is established without affecting the existing transmission network until four transmission new transmission theory until they have finished the removal of three of four transport protocol.

1) Digital Domain Name System

In the digital domain name system, IPv4 and IPv6 are domain name resolutions through the United States, while IPV9 is set by countries, which avoids the limitation of IP addresses and reduces the use of domain names by the state[4]. IPV9 is a "decimal network" with independent intellectual property rights developed according to the invention patent "Method of Allocating Addresses for Computers Using All Digital Encoding". Its decimal network introduces a digital domain name system, which can be used to convert the original binary through a decimal network. The address is converted into decimal text, allowing the computers on the network to connect to each other, to communicate and transmit data to each other, and to be compatible with Chinese and English domain names.

The digital domain name technology used by the IPV9 decimal network reduces the difficulty of network management, the vast address space and the newly added security mechanism, and solves many problems faced by the existing IPv4. The advantages of

other aspects can also meet the different levels of demand for various devices in the future.

2) *Routing*

In terms of routing, the increase in the size of the Internet has caused the IPv4 routing table to swell, making the efficiency of network routing declining. The emergence of IPV9 solves this problem, and the optimization of routing improves the efficiency of the network. IPV9 establishes an IPV9 tunnel between the mobile unit and the proxy, and then relays the data packet sent to the mobile unit's home address received by the "proxy" used as the mobile unit to the current location of the mobile unit through the tunnel, thereby implementing Network terminal mobility support.

IPv6 has a smaller routing table than IPv4. IPv6 addresses are assigned according to the clustering principle, which enables the router to represent a piece of network with one record in the table, reduces the length of routing table in the router, and improves the speed of forwarding packets from the routing table. The address allocation of IPV9 follows the principle of spatial clustering, which enables the IPV9 router to represent a national network and an application network with one record, greatly reducing the length of routing table in the router and improving the speed of forwarding packets by routing table. At the same time, this network can express a specific geographical location[5]. According to this logic, only one route is needed between countries. For example, the route to China is 86. The IPv4 routing table is large and irregular, and the IPv6 routing table is smaller than the IPv4 routing table, but the IPv6 routing table contains no geographic information and the routing is messy.

3) *Security*

IPV9 encryption technology and authentication technology have significantly improved than IPv4, and the encryption technology proposed by IPV9 is difficult to decipher at the physical level, and the confidential performance has been significantly improved. However, at the level of network

information security, there are still many factors that cause insecure network information in China. The fundamental reason is that the root servers of IPv4 and IPv6 are in the United States. Many patents related to the network are in the hands of the United States. At the same time, the risk of information exposure may also be introduced. The IPV9 is to have independent intellectual property rights of Internet Protocol, can bring a lot of protection to the information security of the country[6]. IPV9's address space enables end-to-end secure transmission, making it possible for people to use devices to directly assign addresses. Both IPv4 and IPv6 do not have the concept of national geographic location. Most of their domain name resolution servers are in the United States, and IPV9 proposes the concept of "sovereign equality", which enables each country to have its own root domain name system.

II. INTRODUCTION TO NETWORK ACCESS TECHNOLOGY

IPV9 has a huge IP address resource space, which not only completely solves the current situation of IPv4 address resource shortage, but also far superior to IPv4 network in terms of the number of IP addresses it can use. Due to the large scale of the current IPv4 protocol, no matter which protocol is in use, it is impossible to fully replace IPv4 in a short period of time. It must go through a cyclic and gradual replacement process. Therefore, the problem of transition mechanism should be considered.

In order to successfully complete the process of IPV9 protocol replacing IPv4 protocol, the first consideration is to deal with the relationship between the existing IPv4 network and the future IPV9 network. The problem to be solved is how to achieve a smooth transition of IPV9 network, so that it can solve the problem of IP address shortage in a short time. In fact, the solution of the transition mechanism problem can promote the application of IPV9, which is of great

significance to whether it can become the next generation Internet protocol or just a LAN protocol.

A. Tunnel Technology

Tunneling technology is a technology that converts the data gram in IPV9 format into the data gram in IPv4 format and finally transmits it in the routing system of IPv4 network. A tunnel has a tunnel entrance and a tunnel exit[7]. There is only one tunnel entrance and one tunnel exit. First, at the tunnel entrance, the IPV9 data gram is transformed and processed, and the data information is parsed and encapsulated into a data gram in IPv4 format. The processed data gram is then transmitted along the virtual link identified by the tunnel marker. When the data gram arrives at the exit of the tunnel, it is handed over to the IPv4 protocol. According to the corresponding protocol, the data gram is processed, along with the field value, which is the value of the next header field of the article. After the processing, if the tunnel protocol value can still be detected, the IPv4 header will be discarded and the data gram will be unsealed to obtain the destination address in the original IPV9 message, and then the message will be sent to the original address according to the destination address. At the same time, the transmitted data gram is processed using the IPV9 protocol. During the transition from IPv4 to IPV9, tunneling enabled IPV9 node communication by using existing IPv4 networks. Figure 1 is a schematic diagram of IPV9 data gram encapsulation.

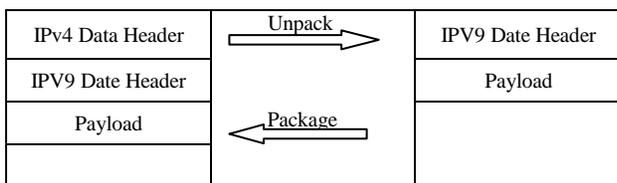


Figure 1. Schematic diagram of IPV9 data gram packaging

B. Double Stack Technique

Dual stack refers to the fact that a single node supports both IPv4 and IPV9 protocol stacks at the same time. Such a node can directly communicate with IPv4 nodes based on IPv4 protocol, or with IPV9 nodes

based on IPV9 protocol. Therefore, it can serve as a connection point between IPv4 network and IPV9 network, and such a node is IPV9/IPv4 node mentioned earlier. Since the new IPV9 protocol stack is mainly aimed at the original IPv4 protocol stack network layer part of the major changes, for the transport layer and other layers above the basic changes, IPV9/IPv4 nodes are usually implemented using a double IP layer structure. This is shown in figure 2.

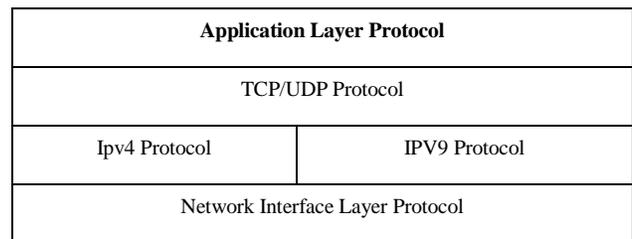


Figure 2. Double IP layer structure diagram

For the router, however, because of the large changes have taken place in IP protocol, and IP routing protocol that is close to the corresponding changes have taken place goes, so "double stack" router is refers to in a router equipment maintenance able and IPv4 two routines by the protocol stack, so that half of the router can also can communicate with host able with IPv4 hosts, respectively support independent able and IPv4 routing protocol, IPv4 and able routing information routing protocols to calculate, according to their different routing table maintenance. The routing table obtained by IPV9 data gram is forwarded according to the routing protocol of IPV9, and the routing table obtained by IPv4 data gram is forwarded according to the routing protocol of IPv4. The router protocol structure that supports IPV9 and IPv4 dual protocol stacks is shown in figure 3.

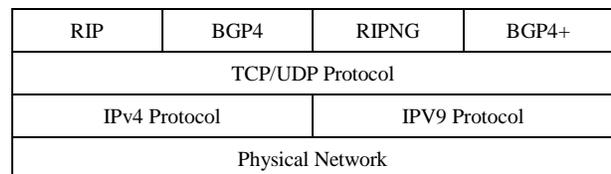


Figure 3. Protocol structure of dual stack router

The network using the dual-stack technology does not have the problem of inter working, so it has certain convenience. However, it needs to assign an IPv4 address to each IPV9 node, which will lead to the problem of IPv4 address resource strain. In addition, every IPV9/IPv4 nodes to run at the same time IPv4 and able two kinds of protocol stack, at the same time save two sets of command set, at the same time calculation, maintenance and storage of two list items, for gateway device also need to two message transformation and encapsulation protocol stack, this undoubtedly and increase the load of each node, higher demands on the performance of these nodes. In addition, DNS servers must support the mapping of host domain names to IPV9 addresses on a dual-stack network.

III. INTRODUCTION TO IPV9 ROUTING EQUIPMENT

With the expansion of the new generation Internet routing system in China, the new generation Internet routing system has been deployed in Beijing, Shanghai, Chongqing, northeast China, Sichuan, Xinjiang, Shandong, Guangdong, Zhejiang, Hong Kong, Macao and other places. Manual configuration of address and route has not been able to meet the current development form, in the configuration, inefficient, complex and other defects have been gradually

exposed. In order to cope with the huge routing node management and configuration, an efficient and automated configuration system is needed to handle the allocation and configuration management of the new generation of Internet addresses.

A. 100-megabit Router

The whole machine of the megabit router is shown in figure 4, including two signal antennas and the main body of the machine.



Figure 4. Whole figure

The panel on the gigabit router is shown in figure 5. The panel includes network connection indicator light, WIFI signal light, USB connection signal light and power signal light.



Figure 5. Panel figure

The warning light of the gigabit router is as follows. When the red light of the power indicator is on, the power supply is normal. When the blue light of WAN indicator flashes, WAN is normal. The blue light of the

LAN indicator flashes when the LAN is normal. When the blue light of WIFI indicator flashes, WIFI is normal; USB is normal when the blue light of USB indicator flashes. The prompt light diagram is shown in table 1.

The front panel is shown in figure 6. The front panel has USB interface and TF card slot. USB interface can be used to connect USB mouse, keyboard, USB disk and other devices. The TF card slot is used to insert the TF card.

TABLE I. LIGHTS TABLE

Indicator Light	Description	Features
	Power Supply	Red light on : Normal
	WAN	Blue light flashing : Normal
	LAN	Blue light flashing : Normal
	WIFI	Blue light flashing : Normal
	USB	Blue light flashing : Normal



Figure 6. Front panel figure

The back panel is shown in the figure 7. The back panel has a DC port, which is used to connect the power supply to the router. Note that using a mismatched power supply can cause damage to the router. The RESET button is the restore button. Press to restart the device. Long press for about 5 seconds to restore the device to the factory default Settings. When the system status indicator changes from slow flicker to

fast flicker, it means that the router has successfully resumed the factory setting. At this time, release the RESET button and the router will restart. The WAN port is the WAN port jack. This port is used to connect Ethernet cables. LAN4, LAN3, LAN2 and LAN1 ports are: LAN port jack. This port is used to connect to a hub, switch, or computer with a network card installed on the LAN.



Figure 7. Back panel

B. Gigabit Router

The gigabit router's whole machine is shown in the figure 8, including six signal antennas and the main

body of the machine. The six signal antennas include four 2.4g antennas and two 5G antennas.



Figure 8. Whole figure

The front panel is shown in the figure 9, and the back panel has a power port, which is used to connect the power supply to power the router. Note that using a mismatched power supply can cause damage to the router. The RESET button is the restore button. Press to restart the device. Long press for about 5 seconds to restore the device to the factory default Settings. When the system status indicator changes from slow flicker to fast flicker, it means that the router has successfully resumed the factory setting. At this time, release the RESET button and the router will restart. The WAN

port is the WAN port jack. This port is used to connect Ethernet cables. LAN4, LAN3, LAN2 and LAN1 ports are: LAN port jack. This port is used to connect to a hub, switch, or computer with a network card installed on the LAN. USB interface can be used to connect USB mouse, keyboard, USB disk and other devices. The TF card slot is used to insert the TF card.

IV. IPV9 ROUTING SETUP PROCEDURES AND METHODS

A. Login Router Configuration Interface

Enter 192.168.1.1 in the browser address bar as shown in the browser login interface below, and press enter to enter the system login interface as shown in figure 10.

Enter the default user name root and the default password shsjzwlxxkjyxgs in the system login interface as shown in figure 11. Click the login button and you will see the overview interface as shown in figure 12.

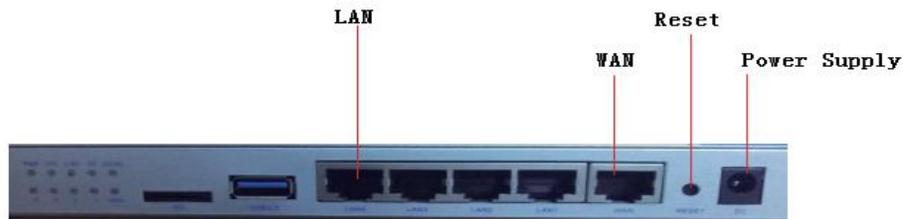


Figure 9. Front panel figure



Figure 10. Browser login

需要授权
请输入用户名和密码。

用户名

密码

Powered by LuCI for-15.05 branch (svn-r2310) / OpenWrt Chaos Calmer 15.05.1 r49389

Figure 11. System login interface

IPv9总览
IPv9接入级路由器，接入虚拟专网，提供IPv9内网服务，保障信息服务安全。通过本产品，您可访问IPv9骨干网提供的DNS/NTP等基础网络服务，并能访问虚拟网络内部架设的开放式应用服务，如视频播放。

互联网连接	在线
Tr069 状态	在线
隧道 状态	在线
IPv4地址	192.168.1.1
IPv9地址	
注册类型	个人
分类编号	TYR200A
设备系列号	58ea3a173bba
设备状态	设备授权
软件版本	0.4.2
自动检测	<input type="checkbox"/>
默认激活VPN	<input checked="" type="checkbox"/>

Figure 12. IPV9 overview interface

B. IPv9 User Registration

Users who use the system for the first time should register before using the router function. User registration is shown in figure 13. The user types are divided into individuals and enterprises. After the

personal router registers the device, the address is automatically assigned without manual allocation. The enterprise router manually assigns the address, and one enterprise account can register multiple devices. Before

you register, you need to send the SMS verification code and enter the SMS verification code.

1) Click the menu IPv9 drop-down key to select the user registration function.

2) Enter the user name, password, confirmation password, registration type, real name, certificate type, certificate number, E-mail, mobile phone, enterprise

name, address, postal code and remarks according to the text prompt of user registration.

3) Enter your phone number and click the send button on the right.

4) After the phone receives the verification code, fill in the verification code.

5) Click the user registration button below.

Figure 13. IPv9 overview interface

C. Equipment registration

When the individual user registers the device, not only the device information is registered, but also the IPv4/IPv9 address is automatically assigned to the device, while the enterprise user only registers the

device information. The device registration is shown in figure 14.

1) Click the menu IPv9 drop-down button to select the device registration function.

2) Choose your city.

3) Click the device registration button below.

D. Configuration of WIFI

Click the network to select WIFI and enter the WIFI configuration interface.

In figure 15, you can see the working state of WIFI. If you need to modify the configuration of WIFI, click modify.

Modify the name of WIFI as shown in figure 16.



Figure 14. IPV9 user device registration



Figure 15. Configuration of WIFI



Figure 16. IPV9 user device registration

Configure the device WIFI encryption method. Generally, it is recommended to use the encryption mode shown (WPA_PSK/WPA2-Psk Mixed Mode) above to enter the new password and click "save &

apply" button. This is the normal router setup, after which a new router is configured. The encryption configuration is shown in figure 17.



Figure 17. Encryption configuration

V. IPV9 AND 5G MOVIE TRANSMISSION SYSTEM

Able movie network issuance application of Beijing Unicom 5G network and China mobile company in Suzhou 5G network has already passed the Beijing university of posts and telecommunications able fiber routing backbone nodes and able backbone fiber optic cable connected directly across the country, and on May 21, 2019, the first in the world at 500 MBPS end-to-end to 1000 MBPS speed, in local access able the national backbone network, successfully carried out the digital film distribution network (each film data capacity in hundreds of GB or so). The national online distribution of Chinese films was the first in the world to enter the new era of "one hour", and the intelligent cinema based on IPV9 address was realized.

The IPV9/IPv4 router is a dual protocol stack router. By building this dual protocol stack router, the IPV9 network can be realized and the IPv4 network can be compatible with IPV9, thus achieving a good transition

from IPv4 to IPV9. Through the configuration of different interfaces of routers, the conversion between different protocols can be realized to realize the data transmission of pure IPV9 protocol packet, IPV9 over IPv4 and IPv4 over IPV9, while IPV9 over IPv4 and IPV9 over IPV9 are realized by tunnel technology, which is an important way to realize the intercommunication between IPv4 and IPV9 networks.

A. IPV9 Private Network Transmission

Figure 18 shows the transmission of pure IPV9 private network. An IPV9 and IPV4 router is directly set up in the state administration of film and the cinema, which is connected through the IPV9 private network. The router interface is configured as the IPV9 transmission mode, so the line between the state administration of film and the cinema is the pure IPV9 protocol transmission. The network between the two is full of IPV9 protocol packets, which can guarantee absolute security.

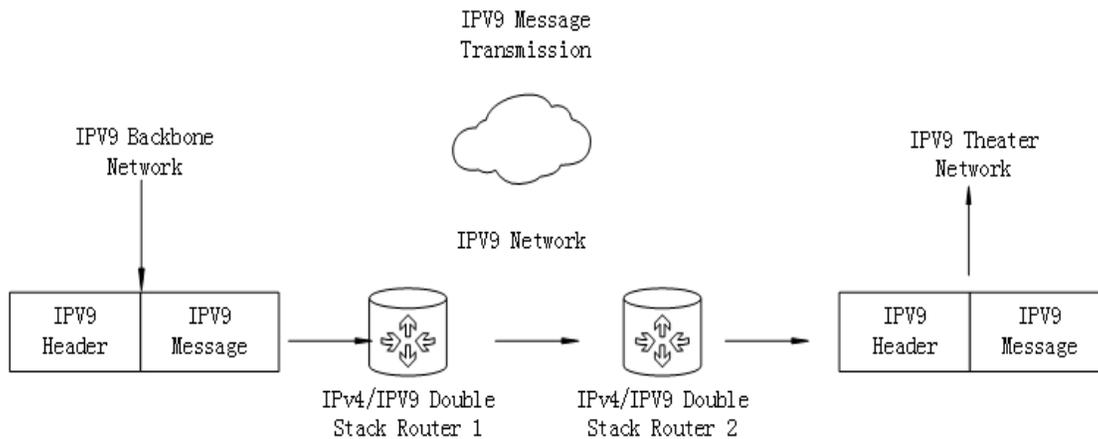


Figure 18. IPV9 private network transmission

B. IPV9 Private Network Tunnel Transmission

IPv4 over IPV9, IPV9/IPv4 router can be compatible with IPv4 network, namely IPv4 packets can be transmitted on the able private network, realize the IPv4 over able, to design a scheme of transmission

as shown in figure 19. Both ends set up double protocol stack router, the router for private network between. The advantage is the backbone adopts able transmission protocol, security can get reliable guarantee.

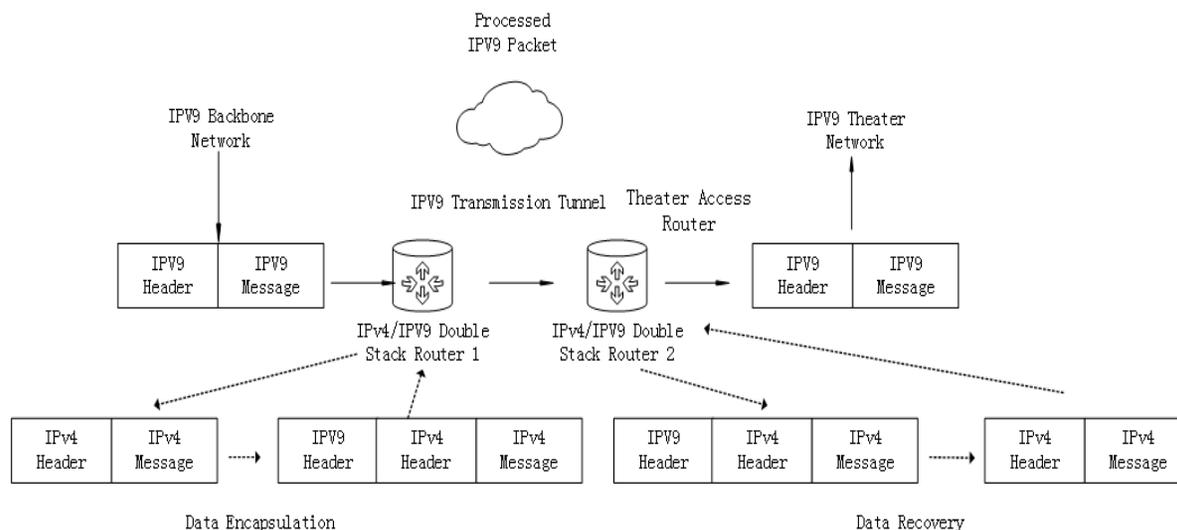


Figure 19. Private network tunnel transmission

The transmission process of IPV9 based IPv4 packets is as follows:

1) Router 1 received IPv4 packets from the IPv4 network.

2) Router 1 encapsulates IPv4 packets in IPV9 message. The source address and destination address of IPV9 message correspond to the entrance address and exit address of the tunnel respectively, that is, the IPV9 address of router 1 and router 2.

3) The encapsulated IPV9 packets are transmitted along and through the marked tunnel link, routed to the IPV9 address, and arrive at the destination router 2 to complete the transmission of IPV9 private network line.

4) Router 2 receives the IPV9 packet from router 1, unseals the IPV9 packet to obtain the original IPv4 packet, and then sends it out.

VI. CONCLUSION

With the development of the Internet and the increasing number of Internet users, the shortage of IP address resources has become a bottleneck restricting its development. The application of IPV9 is spreading in China, especially in the government, Banks and other sectors. IPV9 has a large address capacity, is compatible with IPv4 and IPv6, and uses special encryption mechanisms to make the network environment more secure. This paper discusses the

IPV9 address architecture and the digital domain name system, discusses the different network access technologies in detail, introduces the megabit and gigabit routers that support the use of new networks, and discusses the configuration methods of routers in detail. This paper analyzes the film transmission system of Beijing university of posts and telecommunications at the network level, which is very important for the future deployment of IPV9 network.

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