Discussion on Decimal Network Based on IPV9

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***Abstract*—This paper introduces the core technology of decimal network digital domain name and IPV9 protocol family, and analyzes the technical characteristics of decimal network. Three kinds of common network transition techniques are listed, and various problems of decimal network application are discussed.**

Keywords-Decimal Network; Digital Domain Names; IPV9

I. INTRODUCTION

TCP/IP network architecture and Protocol standards in recent years, computer network research and application of hot technology. At present, the widely used IP protocol is IPv4, based on which the Internet has become the largest computer network system in the world. However, with the rapid development of economic globalization and modern communication technology and network, the scale of computer network is expanding rapidly, and IPv4 protocol starts to expose various problems. Such as: IP address resources, address allocation efficiency is low, no consideration of confidential transmission. Facts show that IPv4 cannot meet the requirements of future Internet development. In this context, countries around the world have stepped up the work of the next generation of Internet protocols. IPv6 has been selected as an international standard by the Internet Engineering Task Force (IETF), while IPV9 proposed in 1992 was abandoned by the ETF due to its large address. Later, with the introduction of digital domain name system (DDNS), gradually developed into a 256-bit address IPV9 decimal network with China's independent intellectual property rights.

II. DIGITAL DOMAIN NAME TECHNOLOGY

The so-called digital domain name, refers to the Arabic numerals (0~9) as the Internet intelligent terminal domain name. The coding of digital domain name refers to the telephone coding rules. It adopts a hierarchical structure according to different regions and consists of root, country/region, and city and user code from top to bottom.

Digital domain names provide users with an alternative to English domain names. At the same time, they have the following characteristics:

- Use of class telephone Numbers to facilitate domain name management and division;
- Make it easier and faster to browse the Internet on smart terminals in the future;
- Provides conditions for the realization of network end-to-end communication in the future;
- Number resources can be integrated to facilitate the integration of the three networks.

Decimal network introduced the digital domain name system, and can be compatible with English domain name, Chinese domain name system. Through the DNS of the domain name server, the digital domain name entered by the user is converted into the corresponding IP address to achieve the purpose of accessing the host. Currently, DDNS maps digital domain names to dynamic IP addresses by installing a small program on the client side. When the user dial-up Internet access, the user will be dynamic IP address and user's digital domain name information notification server, the server will be the user's digital domain name and dynamic IP address registered in the DDNS resolution system, and then began to provide digital domain name resolution services. When the user is offline, the user's digital domain name information is removed from the DDNS resolution system.

At present, digital domain name system and IPV9 protocol has been recognized by some countries and regions. China has developed some IPV9 related network equipment and systems, solved the problem of interconnection between IPv4 network and IPV9 network, and realized the independent function of domain name resolution, domain name allocation, IP address allocation and MAC address allocation. After several years of trial operation, the experimental system established in Jinshan County, Changning District and Fujian province has been successfully tested in five small projects. The Shanghai experimental area is connected to IPv4 networks in Beijing and Hangzhou by tunnel. In addition, various applications based on THE IPV9 decimal network have been developed or are being developed.

III. IPV9 PROTOCOL FAMILY

IPV9 protocol family is a decimal network base protocol, including IPV9 header protocol, address protocol and transition protocol.

A. IPV9 header Protocol

IPV9 packet header format and field meaning are specified, including basic header and extended header.

1) Basic headers

The basic header format specified in the IPV9 header protocol is shown in Table 1.

TABLE I. IPV9 HEADER FORMAT

<table>
<tr><td>version</td><td>category</td><td>Flow label</td><td>Payload length</td><td>Under one head</td><td>Hop limit</td></tr>
<tr><td colspan="6">Source address</td></tr>
<tr><td colspan="6">The destination address</td></tr>
</table>

Version: The length is 4 bits, indicating the protocol version number.

Category: Length 8 bits, 0 to 15 as priority values. The priority classes 0 through 7 are used to specify communication Settings and are used by packet senders to control traffic. 8 to 15 is used to specify traffic that will not fall back in the event of congestion. 16 and 17 assign audio and video, called absolute values, to ensure uninterrupted transmission of audio and video. Others are reserved values.

- Stream label: A length of 20 bits, used to identify packets belonging to the same traffic.
- Net charge length: The length is 16 bits, indicating the number of bytes of the packet behind the IPV9 header.
- Next header: The length is 8 bits, which indicates the protocol type in the header field that follows the IPV9 header.

- Jump limit: The length is 8 bits, indicating the maximum number of times the packet can be forwarded by the node.
- Source address: The length is 256bit, representing the sender address.
- Destination address: The length is 256bit, representing the recipient address.

2) Extended headers

Between the packet IPV9 header and the high-level protocol header, there may be specialized headers, called extended headers, to represent optional Internet layer information. The number of extended headers is small, and each is identified by a different next header value. The IPV9 packet can come with no or multiple extended headers, which need to be defined by the next header field in the previous header. The extended header of IPV9 protocol includes six types: segment selection, route selection, segmentation, destination options, identification and encapsulation of security payloads.

According to the IPV9 header protocol, IPV9 header adopts the form of basic header + extended header chain. Compared to THE IPv4 header, the IPV9 header has removed the header length field and replaced the Type of Service field with the Traffic Class field. The Protocol Type and time-to-live (TTL) fields have been renamed and slightly modified. In addition, the Flow Label field has been added.

Although the total length of the IPV9 base header is nearly four times that of the default IPv4 header (20 bytes), to 72 bytes, it is actually simplified. Because the vast majority of the header is occupied by two 64-byte IPV9 addresses, the rest of the header takes up only eight bytes.

B. IPV9 Address Protocol

The IPV9 address protocol specifies that the IPV9 address is 256 bits, enabling a large addressing space of 2256. According to the data transmission mode, it can be divided into unicast, on-demand and multicast. In addition, the addressing model of IPV9, text representation of IPV9 address, text representation of address prefix, address type representation, monocular address, multiple destinations address and other contents are also specified.

- IPV9 addressing model: Specifies that all types of IPV9 addresses are assigned to interfaces, not nodes.
- Textual representation of 1PV9 addresses: Specifies that IPV9 addresses use "bracket decimal" notation. IPV9 addresses can be divided into pure IPV9 addresses, IPv4-compatible IPV9 addresses, ipV6-compatible IPV9 addresses, special compatible addresses, full decimal addresses, and transitional IPV9 addresses. For convenience of reading, some abbreviations are specified for text representation of addresses.
- Textual representation of address prefixes: Address prefixes for IPV9 addresses are specified to reflect the network hierarchy.
- Address type representation: Specifies some of the high boot bits of the IPV9 address as the format prefix FP to indicate different types of IPV9 addresses. The length of these format prefixes varies.
- Monocular address: Represents a single network interface. Messages addressed to monocular address will be sent to the unique network interface identified by it. The forms of monocular addresses specified in the IPV9 address protocol include the aggregated global monocular address, the decimal Internet address, the domain name decision and assignment organization address, the IPX address, the local IPV9 monocular address, and the IPv4 compatible address.

- Multiple destinations address: A class of IPV9 addresses assigned to multiple network interfaces at the same time. The IPV9 address protocol states that multiple destinations address addresses are assigned from single-mesh addresses, using the same format as single-mesh addresses. When a monocular address is assigned to multiple network interfaces, it is functionally converted to a multiple destinations address.

C. IPV9 Interim Agreement

The IPV9 transition protocol specifies the header format of the IPV9 transition and the definition of the address text representation, addressing model, and node address, including a detailed description of the current transition header and address format defined.

The transitional headers used the original IPv4 header, only changing the version number to 9 to distinguish it from the original IPv4 header. The transitional address adopts the latter two segments of the IPV9 address, a total of 64 bits.

IV. TECHNICAL FEATURES OF IPV9 DECIMAL NETWORK

A. Address space

The wealth of IP address resources is undoubtedly an important advantage of the IPV9 decimal network. Due to the 256-bit address, the theoretical address capacity is 2256, which is said to be able to assign a permanent address to the world's human needs for 750 years, and can be automatically increased sequentially after 750 years. So the address is large enough to solve the IPv4 address resource constraints.

B. Digital domain name System

Digital domain name is an important part of IPV9 decimal network system, which is compatible with English domain name and Chinese domain name. It is impossible to replace English domain names, but it is a good choice for users who are not used to English domain names. In addition, due to digital domain name technology, the decimal network system can be the domain name, IP address, MAC address unified representation into decimal text.

C. Automatic configuration

According to IPV9 plug and play data, IPV9 supports stateless and stately host address automatic configuration, which USES DHCP of IPV9.

D. Security

The special encryption mechanism is adopted to ensure the safe transmission of network data.

E. Mobility support

The IPV9 decimal network establishes an IPV9 tunnel between the mobile unit and the home agent, and then relays the packets to the mobile unit's home address received by the "proxy" of the mobile unit through the tunnel to the current location of the mobile unit, so as to realize the support for network terminal mobility.

IPV9 decimal network introduced the digital domain name technology, convenient digital button Internet, simplified the difficulty of network management. The expansion of address space and the introduction of security mechanisms have solved the problems faced by IPv4 networks. Support for QoS, automatic configuration, and mobility enables it to better meet multiple business requirements. IPV9 protocol can theoretically meet the requirements of the new generation of Internet development. At present, after the experimental verification stage, completed the development of basic hardware equipment, has entered the stage of small-scale application.

V. TRANSITION TECHNOLOGY FROM IPV4 TO IPV9

Although IPV9 has many technical features and can solve various problems faced by IPv4, IPV9 has a long history. The IPV9 decimal network is not likely to replace the huge IPv4 network in a short time, but will go through a long process of coexistence and transition. Drawing on a number of IPv6 technologies, lPv9 also supports the IETF Next Generation Internet Transition Working Group to propose dual stack, tunneling technology, and NAT-PT (Network address translation/protocol translation).

A. Dual protocol stack technology

This is the simplest way to handle transition problems. This mechanism enables the device to handle both types of protocols by running both 1PV9 and IPv4 stacks on a single device, as shown in Table 2.

TABLE II. STRUCTURE DIAGRAM OF DOUBLE PROTOCOL STACK

The application layer	
Transport Layer (TCP/UDP protocol)	
IPv4	IPV9
Network interface layer	

The dual stack mechanism is intuitive and easy to understand. The problem is that the dual stack still requires the corresponding host to configure IPv4 addresses, otherwise it is invalid, which goes against the original intention of using IPV9 to solve the problem of insufficient IPv4 addresses. In practice, it is impossible for all hosts or terminals to upgrade to support dual stacks, and using dual stacks will increase the burden on hosts and reduce performance. Therefore, the application must be combined with other technologies.

B. Tunneling Technology

Tunneling provides a way to pass IPV9 data over existing IPv4 routing systems, as shown in Figure 3. The technical principle is that at the entrance of the tunnel, the router encapsulates the 1PV9 data packet into the IPv4 packet, whose source address and destination address are the IPv4 addresses of the tunnel entrance and exit respectively. The encapsulated IPv4 packet will be transmitted through the IPv4 routing body, and the protocol domain of the packet header is set to 141. Indicates that the load of this packet is an IPV9 packet, which is taken out and forwarded to the destination station at the exit of the tunnel.

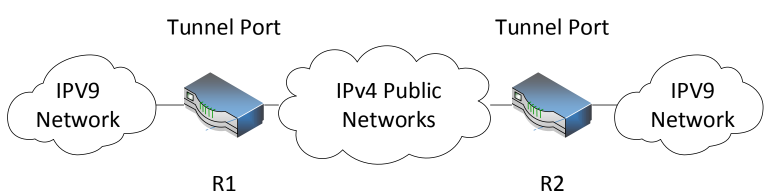

Figure 1. IPV9 over IPv4 tunnels

Tunneling technology requires modifications only at the entrance and exit of the tunnel, with no other requirements, and is therefore very easy to implement. It is currently the most widely used transition technology, the disadvantage is that IPV9 host and IPv4 host cannot achieve direct communication. Transitional IPV9 decimal network supports two tunnel technologies: IPV9 over IPv4 and IPv4 over IPV9, which can be divided into automatic configuration and manual configuration according to address configuration. The improved technology includes tunnel agent technology.

C. NAT - PT

Nat-PT technology is a protocol translation technology that performs both header and semantic translation (PT) between IPv4 and IPV9 packets while performing IPv4/IPV9 address translation (NAT). Through the introduction of Nat-PT router, the intercommunication between IPv4 sub-net and IPV9 sub-net can be realized. The network structure is shown in Figure 2.

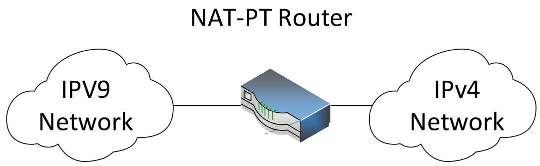

Figure 2. Nat-PT network structure diagram

Nat-PT can solve the problem of tunnel technology and realize direct communication between IPV9 and IPv4 host, which is suitable for the initial stage of the transition of IPV9 network with small scale.

VI. CONCLUSION

The decimal network is based on the digital domain name and IPV9, two core technologies independently developed in China, with independent intellectual property rights. At the same time, it can solve various problems faced by the existing IPv4 network and meet the requirements of the development of the next generation of Internet. If it can be applied and popularized, it will promote the great development of the Internet and help China get rid of the situation of being restrained by others in Internet technology. However, the establishment and promotion of standards is not a simple technical issue, which involves the interests of various countries and groups. Therefore, the popularization of decimal network cannot be accomplished overnight, so it should be supported by the state and applied in government departments, military departments and other departments with higher requirements on network performance and security. And then gradually spread to achieve business operations. At the same time, it is also necessary to coordinate the relationship between domestic and foreign interest groups and promote their international standardization process, so as to finally achieve the goal of completely replacing the existing IPv4 network.

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