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Autonomous Extensible Internet with Network Address Multiplexing(AEIP NAM) draft-diao-aeip-nam-04.txt

Abstract

The two key issues of today's Internet are autonomy and extensibility. Autonomous Internet(AIP) technology can provide extensible internet architecture, own independent root DNS servers and self management internet network; Furthermore, based on the Autonomous Internet, here provides a way with extensible address capacity to solve IP address deficiency and realize Autonomous Extensible Internet(AEIP) with global network address and multiplexing local network address. This AEIP with Network Address Multiplexing(AEIP NAM) can realize autonomy and extensibility with minimal cost.

Status of this Memo

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1. Introduction

Internet has become an important strategic resource for its rapid development all over the world. Therefore, to solve the two key issues of Internet, autonomy and scalability, is particularly important.

The essence of Internet autonomous problem is to solve the domain name problem, so as to provide extensible architecture, provide multi-polar, self-control, self-management over the Internet, own independent root domain name server in each autonomous internet (AIP) network, and safeguard global Internet without quarrel.

The essence of Internet scalability problem is to solve the IP address shortage problem. Private network solution, dynamic address assignment technology, VLSM technology and NAT technology proposed in the field can only slow down the speed of the IP address depletion. Due to slow progress and many unsolved problems, IPv6 can not timely solve the IP address shortage problem and meet the needs of rapid developing Internet. The huge demand of Internet encourages that people must seriously consider the scalability of the IP network in reality.

This article will discuss the IP network's scalability on the base of Autonomous Internet, so as to solve the current problems caused by IP address shortage, to realize the autonomy and extension of the Internet.

1.1. Specification of Requirements

In this document, several words are used to signify the requirements of the specification. These words are often capitalized. The key words "MUST", "MUST NOT", "REQUIRED", "SHALL", "SHALL NOT", "SHOULD", "SHOULD NOT", "RECOMMENDED", "MAY", and "OPTIONAL" in this document are to be interpreted as described in [RFC2119].

2. Autonomous Internet Technology

Autonomous Internet(AIP) technology provides a way to own independent root domain name servers to realize Autonomous Internet without necessary to overturn the Internet infrastructure. It provides Internet global equality, secure autonomy, green extensibility.

According to the AIP autonomous DNS, the domain name hierarchy can be designed distributedly and provide each AIP network autonomy; Each AIP network has its root DNS servers, which are responsible for all the DNS resolution in this AIP network. Other DNS servers of this AIP network should point to these root DNS servers by default. Each AIP network is almost the same as the current Internet, and the internal domain name resolution and IP node communication have not any change. The only change is that the destination domain name need add domain name suffix of the destination AIP network when IP nodes communicate between different AIP networks. Domain node "www.yahoo.com" in network B is expressed as "www.yahoo.com.B" for its external domain name. So each AIP domain name hierarchy tree adds the top-level domain name "ex(i)", so as to map the other external AIP domain name hierarchy trees accessible from this AIP network. When ex(i)=B, it means that the other AIP network B is accessible from this AIP network. At the same time, each AIP network will add a kind of device called "AIP DNS gateway" to support domain name resolution between AIP networks.

3. Autonomous Extensible Internet (AEIP NAM)

Autonomous Extensible Internet(AEIP) is feasible not only in practice but also in technology. In practice, the communication traffic is relatively much smaller between different languages and cultures, and convergence of language and communication traffic brings the reality of Internet autonomy. In technology, AIP can deploy easily and cause the least change, provide security, autonomy and extension in architecture. AIP is distributed Internet architecture. This architectural distribution provides more choices and possibilities in solving IP address deficiency problem.

Hereinafter, a technology would be introduced to realize extensible Internet, which is so call Autonomous Extensible Internet with Network Address Multiplexing (AEIP NAM). AEIP NAM mainly adopts global network address, and multiplex local network address, which is based on AIP architecture.

3.1. Network Extensible Design

AIP can not only solve the Internet autonomous problem but also make architecture extensible with its distributed architecture. The internet network can realize extension by adding some AIP network entities as need. But IP network address deficiency makes it necessary to further achieve scalability on the IP network address, so as to realize the extensible Internet indeed. IP network scalable address space realization method is described as following:

First of all, the Global Network Address(GNA, namely public IP address) is adopted for interoperability between different AIP networks. Unique GNA between AIP networks need global negotiation and unified plan. (In special situation, it can be negotiated and planed by directly connected AIP networks themselves.) Different GNA ranges will be arranged to different AIP networks. GNA is assigned for IP node used for global server or mainly used for interoperability among AIP networks. Here would not be any change to current global communication with public IP address. After new added AIP network realize autonomy by AIP technology, it can use current or reserved public IP address for inter-network communication. Therefore, current Internet public IP address space arrangement can almost keep unchanged.

Secondly, based on each AIP network, the concept of "Local Network Address(LNA)" is introduced to extend global Internet IP address quantity. LNA is only used for inner communication within AIP network as need. LNA consists of considerable ratio part of the whole IPv4 32-bit address capacity. It is designed for AIP single system and can be multiplexed for each different AIP single system.
Now the IP address is almost exhausted up, so LNA needs to be converted from public IP address, no matter whether these public IP addresses are already in actual use or not. Then the total available IP addresses of each AIP network is the sum of reusable LNA and unique GNA arranged for this AIP network.
For example, if the multiplexing LNA occupies 1/4 ratio of the total IP address space, namely about 1 billion IP addresses, so there are billions of addresses besides its currently used GNA for each AIP network and can satisfy its address quantity requirement. Furthermore, multiple AIP networks can be added as need and provide additional times of available IP address quantity. Generally in each AIP network, IP nodes only configure LNA or GNA and they can communicate to each other peer-to-peer directly. AEIP NAM network is almost the same as AIP network in Autonomous Internet technology. Its internal communication is independent from external AIP network and it is not necessary any upgrade and transformation for current IP nodes.

Moreover, Private Network Address (PNA, namely private IP address) would still keep using as multiplexing private network address within each AIP network of AEIP NAM.

Fig. 1 shows the realization of Autonomous Extensible Internet (AEIP NAM)

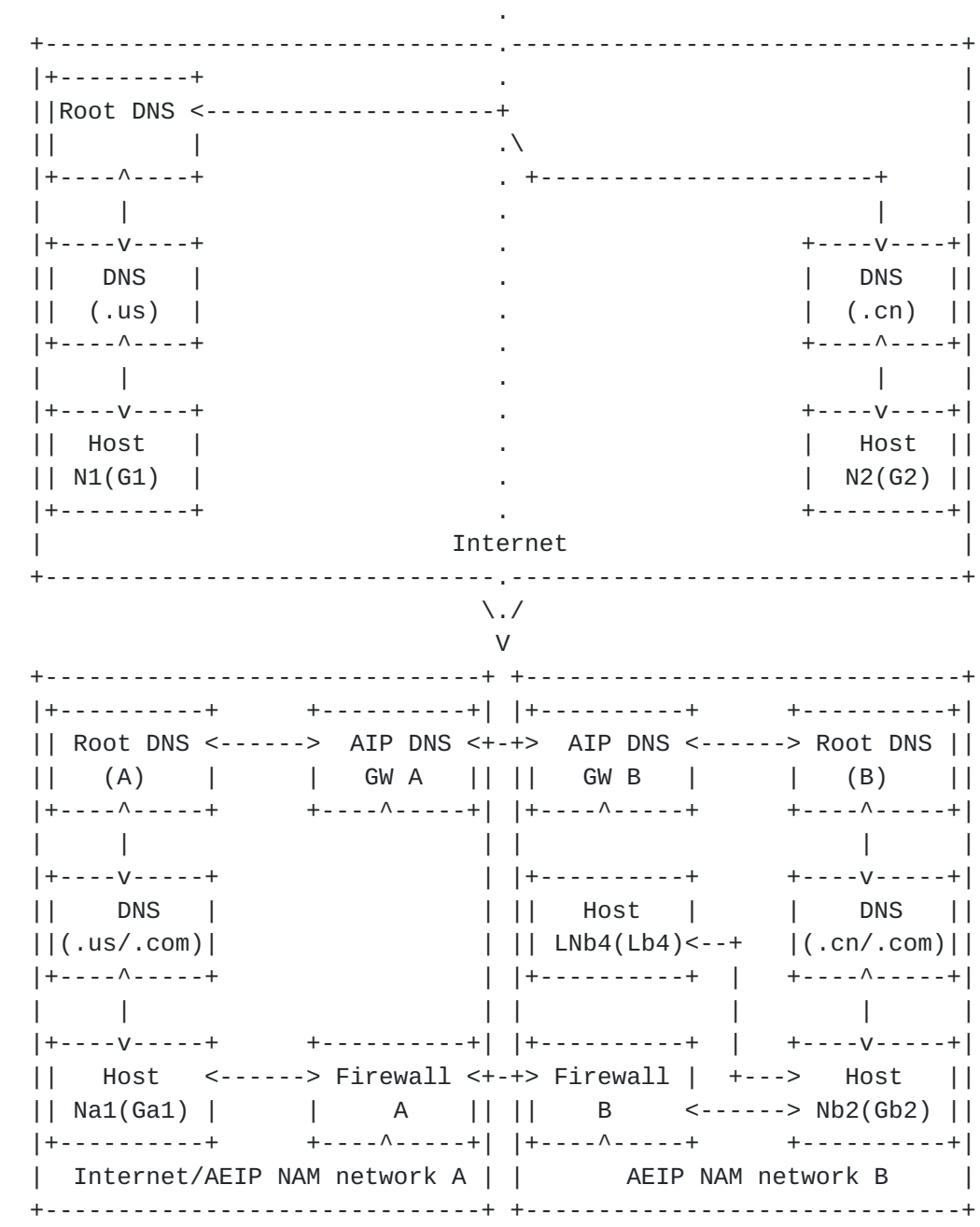

Figure 1: AEIP NAM realization

Note: IP host is labeled as DomainName(IPAddress). Prefix "L" denotes nodes with LNA. Prefix "G" denotes nodes with GNA. AIP DNS GW is a gateway for DNS resolution between AIP networks.

3.2. DNS Firewall

In order to realize AIP network's thoroughly independent domain name management and avoid internal domain name revealed to other AIP networks, domain name can be isolated by AIP network DNS gateway in AEIP NAM.

In order to prevent unauthorized access to AIP network internal domain name from other AIP networks, domain name range opened to other AIP network access can be set in this AIP network DNS gateway ingress.

Correspondingly, in order to prevent unauthorized access to other AIP network internal domain name from this AIP network, domain name range opened to this AIP network access can be set in this AIP network DNS gateway egress.

3.3. Address Firewall

In order to prevent causing confusion and avoid LNA used in this AIP network revealed to other AIP networks, LNA can be isolated by AIP network firewall in AEIP NAM.

In order to prevent IP packet with LNA in its source address field or destination address field infiltrating into this AIP network from other AIP networks, access denial to IP packet with LNA in its source address field from other AIP networks should be set in this AIP network firewall ingress; and access denial to IP packet with LNA in its destination address field from other AIP networks should be set in this AIP network firewall ingress.

IP nodes using LNA is generally only suitable for AIP network internal communication. In order to prevent IP packet with LNA in its source address field or destination address field infiltrating into other AIP networks from this AIP network, access denial to IP packet with LNA in its destination address field from this AIP network should be set in this AIP network firewall egress.

Moreover, access denial to IP packet with LNA in its source address field from this AIP network should be set in this AIP network firewall egress. Or some unidirectional dynamic communication between AIP networks such as web browsing, can be implemented by simple NAT method and might have some service limitation.

3.4. Extensible Address Capacity

Based on the extensible network architecture of autonomous internet, AEIP NAM designs a set of multiplexing address space and can always provide a set of ready address space for new added single AIP network system entity. Thus it can effectively solve IP address deficiency problem of Internet and remove the barrier to Internet extension.

This set of multiplexing address space includes three parts: the LNA L, the GNA G and the Private Network Address P. These three types of network addresses are divided properly using existing Internet 32-bit address space C. The size of the existing Internet address space is C=2^32, and P=2^16+2^20+2^24. Then we have C=G+L+P and approximately

$$C=G+L \qquad (1)$$

The GNA subspace is not for multiplexing. The LNA resources in each AIP network of AEIP NAM include a certain proportion of address space of existing Internet, and they can be multiplexed in different AIP network. In general, all IP nodes can communicate with each other directly within each AIP network no matter they are assigned LNA or GNA. But only IP nodes which are assigned GNA in one AIP network can communicate directly with those nodes that are assigned GNA in other AIP networks.

Assume that there are m of such AIP networks, each of them has GNA quantity g(i) and LNA quantity l(i). Then the total capacity of the AEIP NAM extensible address space C' can be counted as

$$C'=m*[g(i)+l(i)] \qquad (2)$$

Since the LNA is multiplexed in different AIP networks and each AIP network can use the entire LNA space L, so the maximum total capacity of the AEIP NAM address space

$$C'max=m*[g(i)+L]=C+(m-1)L \qquad (3)$$

According to (3), we can obtain the Change trend figure of total address extension capacity. The maximum address capacity C'max increases linearly when the AIP network number m increasing with specific ratio LNA capacity. In this way, the design of AEIP NAM can add AIP networks as need and greatly increase the IP address capacity synchronously. So the extension of network is achievable.

3.5. Constraint Condition of Extensible Address Space

According to the statistics, most of the several thousand languages surviving currently have less than 100 thousand users, so call "ethnic language". Some of them have only thousands of or even hundreds of users. The 90% of them will disappear after several generations. There are about 200-250 languages which have more than 1 million users. Twelve languages among them have more than 100 million users, which cover most of the countries all over the world (the simple accumulative total number of countries is 201) and is used by over 3.5 billion users or 60% of the world population.

The six work languages approved formally by United Nations are English, French, Russian, Chinese, Spanish and Arabic. The population using Chinese is 907 million or 15% of the world population. There are over 1.3 billion people in China and most of them use Chinese while some minorities use their own languages. The population using English are 456 million, but the number of people who are learning English is more than 1 billion. English is the most powerful language in the world and is used as official language by 75 countries all over the world. In addition, French has been applied widely in the international social and diplomatic activities, whose rank is only secondary to English. It is not only the official language of France, but also the official language or common language of 42 countries or regions in five continents. The population speaking French are about 120 million including over 50 million native French.

Therefore, in order to aggregate the great communication traffic using the same language, a single AIP network need to reach about 1 billion users or C/4 IP address scale at least. So the capacity of Local Network Address L designed in Autonomous Extensible Internet AEIP NAM should be greater than or equal to C/4. Thus the capacity of Global Network Address G is less than or equal to 3C/4 according to (1). In addition, the design idea of AEIP NAM is mainly based on the global address. The capacity of Global Network Address G should be greater than or equal to C/2 and L is less than or equal to C/2 accordingly. So the constraint condition of AEIP NAM extensible address space is

$$L \sim [C/4, C/2];\ G \sim [3C/4, C/2] \qquad (4)$$

4. Conclusion

Based on Autonomous Internet architecture, Autonomous Extensible Internet with Network Address Multiplexing (AEIP NAM) mainly adopts Global Network Address, and multiplexes Local Network Address to realize extensible Internet. It provides an integrated solution to Internet autonomy and extension issues. In practice, it has little reformation work, smooth transition and can be implemented even in unilateral technical action to realize Autonomous Extensible Internet.

5. Security Considerations

There is no additional security requirement than current Internet system. Security issues are not discussed in this memo.

6. IANA Considerations

According to the AEIP NAM solution and the constraint condition of extensible address space, IANA need to plan proper ratio of GNA and LNA in 32-bit IP version 4 address capacity and adjust their assignment in different AIP networks.

7. Acknowledgments

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