A DETAILED APPROACH FOR MIGRATION PATH TO IPV6

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Abstract

Today, some institutions have already owned their IPv6 address ranges, but they couldn't use them. Main reasons for this are still common use of IPv4 and insufficient IPv6 support provided by ISPs. Many techniques have been developed to provide this migration period. But there is no exact road map already. In this study, 6 different stages and the techniques that can be used in the migration period were defined.

Keywords: IPv6, Teredo, 6to4, ISATAP, Migration, Anycast

INTRODUCTION

Today every network device comes with the IPv4 support. The IPv6 protocol has been developed due to the limited number of IPv4 address range and the depletion of this number.

YEAR	ASSIGNED CLASS A IP RANGE	REMAINING CLASS A NUMBER	TOTAL REMAINING IP ADDRESSES
2000	4	102	1.711.276.032
2001	7	95	1.593.835.520
2002	4	91	1.526.726.656
2003	5	86	1.442.840.576
2004	9	77	1.291.845.632
2005	11	66	1.107.296.256
2006	10	56	939.524.096
2007	13	43	721.420.288
2008	9	34	570.425.344
2009	8	26	436.207.616
2010 (till November)	14	12	201.326.592

Fig. 1. Assigned IP Address Ranges by Year (values from IANA.org [1])

The chart in Fig.2, which is created based on the values in Fig.1, shows that the number of unassigned IPv4 addresses keeps decreasing almost with the same speed. Possibly with this consumption rate, IPv4 addresses will run out in less than two years. Because of this, IPv6 migration period should start immediately.

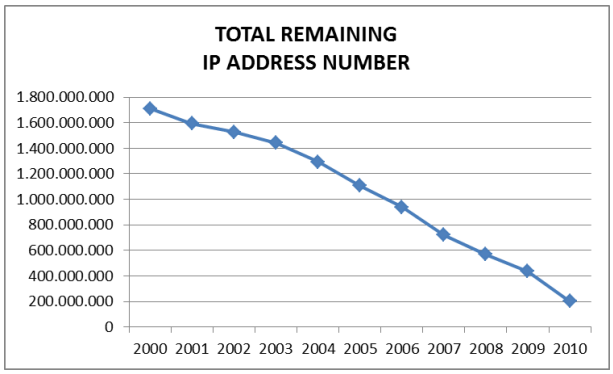

Fig. 2. Total Remaining IP Address Number

However all IPv4 supported devices and services could not support IPv6. Therefore, various methods could be applied to benefit from existing devices and systems at the IPv6 migration period. This period could be modeled in 6 forms of different stages. Managers should concentrate on stages that are suitable for them.

IPV6 MIGRATION PERIOD

1. Stage: Using IPv4 along with IPv6 by the help of Dual-Stack systems.

In the first period, migration of all clients to IPv6 and fully abandoning IPv4 is not feasible. For this reason, a mechanism named "Dual-Stack" and operating systems which support this feature has been developed. This feature allows clients to carry out IPv4 and IPv6 access at the same time. This support is available in modern operating systems and network devices. Thus many users have been passed to Dual-Stack unconsciously. [2]

DNS servers have already begun to respond to either IPv4 or IPv6 queries for facilitation of Dual-Stack. IPv6 DNS records named as "AAAA" or "A6" must be defined at DNS servers. If there is both IPv4 and IPv6 DNS record available for the same domain name, DNS servers will prefer IPv6 address.

From now on all the new generation operating systems, server applications and most of the network equipment are coming with the "Dual-Stack" support. Namely; 1st stage is over already.

2. Stage: Deploying only IPv6 enabled services.

At the 2nd stage to expand the usage of IPv6, servers that support only IPv6 can be installed at corporate intranets. This procedure increases the IPv6 experiences of the system managers and the users.

3. Stage: Implementation of tunneling for communication of only IPv6 enabled servers and the clients over the IPv4 service providers.

There are two problems about communication of IPv6 enabled only servers from outside of their networks. Firstly, today most of the service providers give only IPv4 support. The second problem is that, many of the internet access routers that SOHO users use to connect internet, only support IPv4. At the beginning, the users will not invest for new equipment for this kind of service.

The tunneling techniques have been developed for the solution of this problem. Previously, the protocols such as IPX and AppleTalk are carried on IPv4 with the tunneling techniques. In the same way, IPv6 packets could be carried on IPv4 with only adding 20 bytes of IPv4 header in front of IPv6 header. With this technique two IPv6 clients could easily communicate over IPv4 backbone. The development of the tunneling techniques has begun in the late 90's. Generally these techniques are divided into two sections. The first technique is the static tunneling which is configured at the edge routers of the big institutions. But this solution cannot provide assistance to the end users for accessing from home. The second solution is the dynamic tunneling techniques offering more flexibility. There are many other dynamic tunneling techniques also. Only the three of them, which covers different needs, are commonly supported by the modern operating systems.

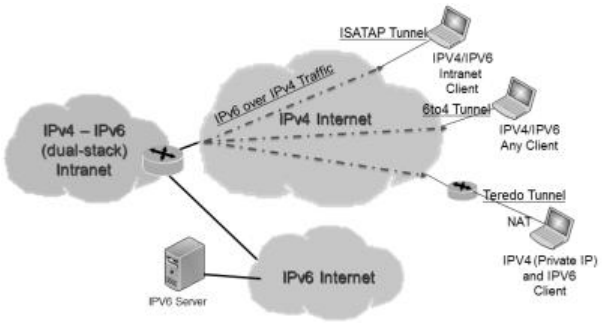

Fig. 3. Tunnel techniques

These techniques are;

a. ISATAP: This technique is developed for a company's own staffs and departments which enables them to communicate with IPv6 networks through IPv4 clouds.[3]
b. 6to4 Tunnel: This technique is developed for different users to make IPv6 communication through IPv4 clouds. "Dual-stack" support at both source and destination is enough for 6to4 technique. But communication between "Dual-Stack" working client and only IPv6 supporting server needs special gateway equipment. These gateways need high bandwidth to serve wide communities. For that reason, this must be the service that is supplied by Internet service providers. In this migration period, many voluntary organizations are giving free 6to4 services when the IPv6 traffic is not intensive. [4]
c. Teredo: This technique has the same logic with the 6to4 tunneling. Clients, reaching to external networks through an IPv4 NAT router, could also communicate with IPv6 clouds using Teredo. This technique could be the most common technique, because most of users access Internet through a NAT router. [5]

4. Stage: The usage of "anycast" to reduce the load of routers at tunnel aggregations.

In case of widely usage of the 6to4 and Teredo tunneling techniques, this means when the public usage starts, a single aggregation router will be insufficient for regional usage.

For that reason anycast technique which was used formerly to reach the nearest server can be offered for this purpose also.

Anycast is not an innovation that comes with IPv6. It is the technique that is recognized firstly in 1993. It is based on the assignment of same IP address to more than one server or device in different geographic locations. Anycast operates with the current routing protocols without the need of special one. [6,7]

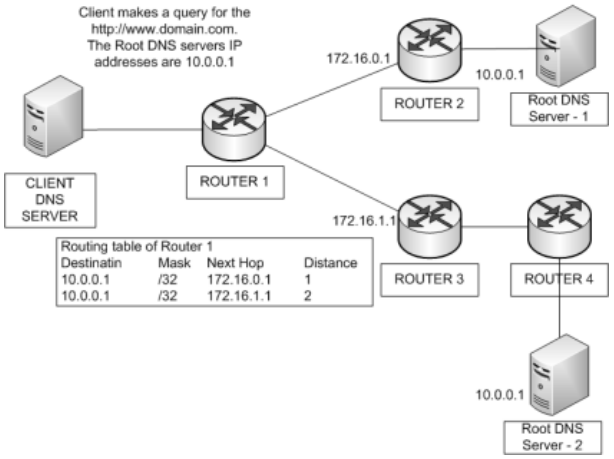

Fig. 4. Example of Anycast

Despite of the anycast identified in 1993, it doesn't have a wide usage area and so it isn't well known. It is used widely and efficiently by Root DNS Servers. Currently 7 of 13 Root DNS Servers are using the anycast technology. [8] With the same technique the load of tunnel router could be reduced also. And it could allow tunnel router to serve to more users.

5. Stage: Installation of NAT-PT routers to communicate with older devices that only support IPv4 after the migration to IPv6.

After a period of time, the internal network will be operated with IPv6 only. However there could be previously supplied and only IPv4 supported devices such as printers, laboratory devices, Uninterruptible Power Supplies and manageable switches. The support of these devices should continue.

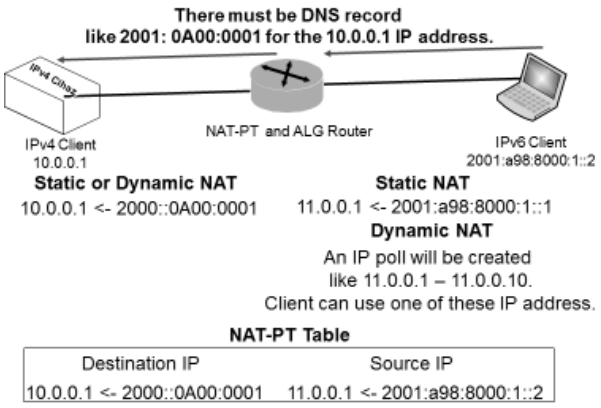

Fig. 5. NAT-PT from IPv6 to IPv4

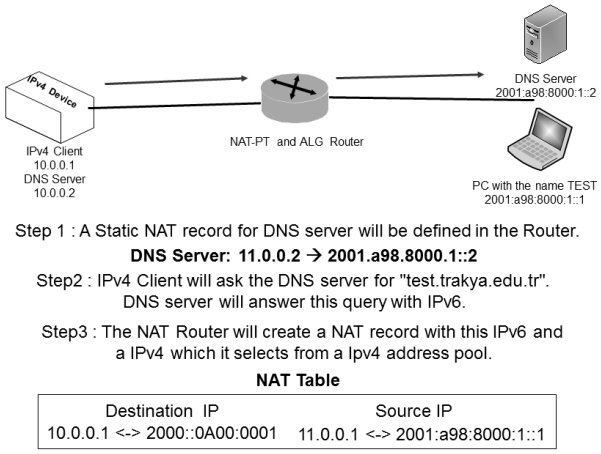

Fig. 6. NAT-PT from IPv4 to IPv6

NAT-PT (Network Address Translation – Protocol Translation) is designed for the communication between only IPv4 supported devices and only supported IPv6 devices. [9,10,11] Standard NAT converts an IPv4 address to another IPv4 address only. NAT-PT is not changing the IP addresses only. It regenerates the IPv4 header as an IPv6 header also.

6. Stage: This is the stage when all devices support IPv6 and only IPv4 Supported devices reach their end of life.

At the last stage, the usage of IPv4 which has become active in 1970's will come to an end. The equipment that have only IPv6 support will be used. So the result is end of both NAT process and the usage of private IP addresses. This will provide significant amount of advantages. But NAT technique provides an easy firewall solution. Without usage of NAT, many security issues will be seen.

CONCLUSION

Unallocated IPv4 addresses are running out. Before the last IPv4 address space is assigned, IPv6 migration period should be completed. Fig. 7 shows that serious number of LIR's (Local Internet Registry) has not requested for their IPv6 address blocks. This also shows that most of organizations do not have IPv6 migration plan in the near future.

Country	Local Internet Registry	Global IPv6 allocations and assignments	Allocation Percentage
Albania	17	0	0,00%
Bulgaria	70	18	25,71%
Croatia	23	9	39,13%
France	322	143	44,41%
Germany	705	379	53,76%
Greece	37	15	40,54%
Hungary	80	25	31,25%
Italy	429	94	21,91%
Poland	193	89	46,11%
Romania	38	18	47,37%
Turkey	106	28	26,42%

Fig. 7. Global IPv6 Allocations Percentage [12]

The IPv6 migration process could be implemented in 6 steps as describe in paper. However this could realized at more or less steps according to the need. It is certain that, every network manager has to start this migrating process as soon as possible.

It is certain that, after the IPv6 migration finishes, management of the network become more complex. Although users and network administrators is not familiar with IPv6, network administrators should provide maximum availability with providing minimum interruptions at the IPv6 migration process. Because of this, network administrators should be trained about IPv6 and they should increase their knowledge immediately.

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