2005 Version

IPv6 Deployment Guideline

A Case Study for a Large Enterprise to Introduction IP Telephony in Their Network

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IPv6 Promotion Council of Japan
DP-WG Large Enterprise, Local Government and SOHO SWG

Case Envisaged

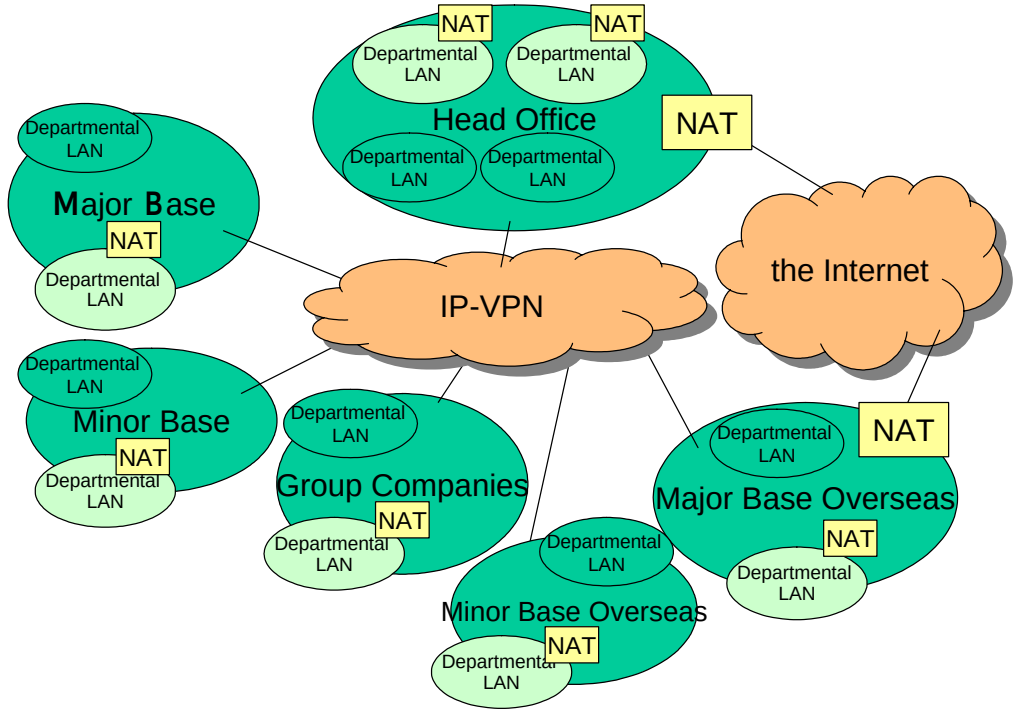
Taken up here is the case of a certain large enterprise, who has introduced the IP telephony subject to IPv6.

Company B has an entrepreneurial size enough to have 10,000 employees all over the nation plus a group workforce totaled at 7,000 employees, with another 5,000 people working at their subsidiaries overseas. As far as the wide area network (WAN) services are concerned, Company B is an IP-VPN user both in Japan and overseas. Their network (VPN) is configured in a tree formation, with the head office centered in the system. To avoid a possible address collision, Company B has had the NAT equipment installed interdepartmentally. And major bases overseas are connected with the head office, too. And bases overseas are interconnected in the tree formation, with major bases centered. As far as an Internet connection is concerned, their bases inside Japan are linked via the head office. As far as their bases overseas are concerned, Company B permits them to connect with the Internet by way of some major bases overseas rather than the head office in Japan.

- A large enterprise is envisaged to have a network as follows:
  - Parent company has domestic total workforce of 10,000 employees.
  - Group member companies in Japan have a total workforce of 7,000 employees.
  - Subsidisaries overseas have a total workforce of 5,000 employees.
  - For WAN services, the enterprise have applied IP-VPN both in Japan and overseas.
  - The enterprise has the network configured in a tree formation, with the head office centered.
  - The enterprise has NAT equipment installed in each department to avoid a possible collision of addresses.
  - The enterprise has major bases overseas connected to the head office.
    - The network configuration overseas is formed in a tree, with major bases centered.
  - Internet Connections
    - Each base in Japan is connected via the head office.
    - Bases overseas are connected via major ones overseas.

	No. of Bases	Workforce per base	Total
Head Office	1	5000	5000
Major Base	5	700	3500
Minor Base	15	100	1500
		Subotal	10000
Group Members in Japan	10	700	7000
Major Bases Overseas	5	700	3500
Minor Bases Overseas	15	100	1500
		Subtotal	12000
		Total	22000

Network Concept



Motivations and Problems in Company B's Network

For the backgrounds where Company B had introduced VoIP subject to IPv6, their network prior to the introduction had its situations as discussed here.

It was necessary for Company B to make their network cope with a consolidation or de-consolidation of their in-house departments, and with an expansion of their business size due to an M&A project. To proceed with such action, the following problems might well be taken up:

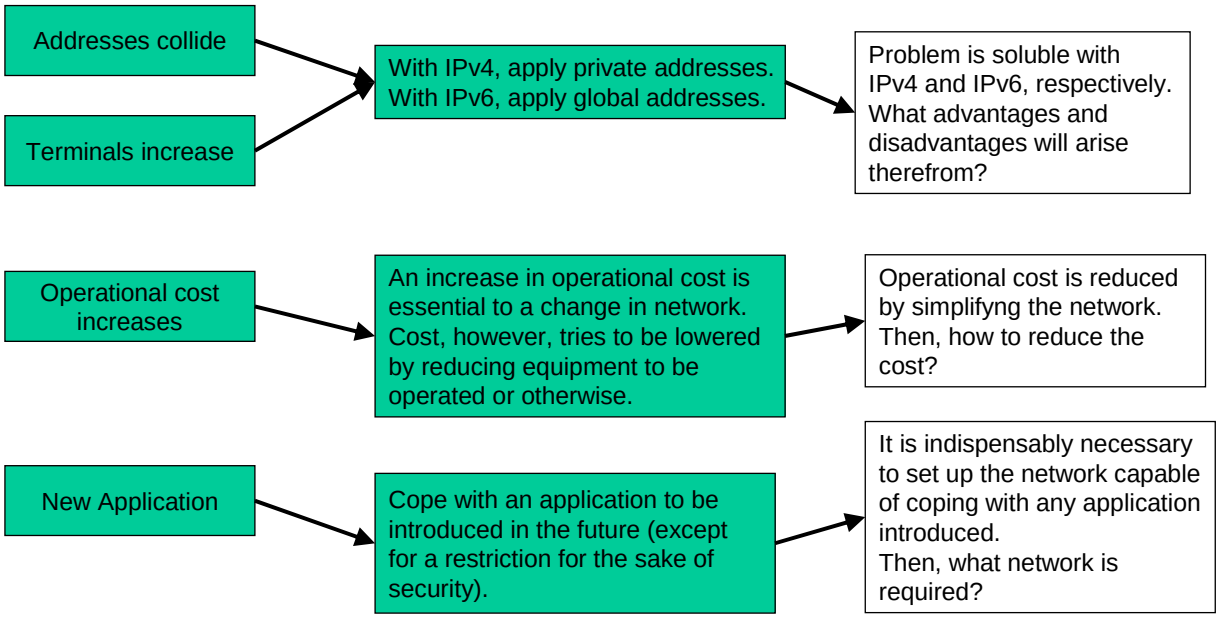
- Private addresses set up under IPv4 may collide with those which have arisen from an entrepreneurial consolidation.
- Wireless LAN telephony is likely to be introduced increasingly in addition to a growth of the in-house PC population, leading to an increase in number of terminals. (= A subnetwork will have its design complicated more than ever.)
- A larger number of equipment units will be introduced, leading to an increase in network management cost.

It is necessary for the Company to study any possible solutions to the above-mentioned problems while taking into account the trends of technologies and services in the future as

well as the effectiveness of investment. To do so, the address-related problems should be resolved, first of all, because a lot of problematical items involve an address.

Either IPv4 or IPv6 provides you with solutions to a collision of private addresses and to an increase in number of terminals. It is necessary, however, to take into consideration their respective advantages and disadvantages. An increase in operational cost may be coped with by simplifying the network. A real question, however, lies in how to materialize the network simplification. To cope with an application in the future, moreover, we should focus on how the network could simplify itself.

Solution Policy



As far as it is thought out under IPv4, there are high possibilities that the network may be set up on a patch-work basis, that working applications may be limited and that the cost may increase due to an increment of the objects to be managed by the network.

Now, let's think about the address collision and terminals' increase issues, first of all.

The IPv4 network provides us with the following four options as a specific solution to the problems:

- Continue using NAT.
- Re-allocate addresses every time so as to avoid a possible collision of private address ranges on an inter-base basis.

- Change the net mask rather than changing the address range.
- Use a secondary address.

A table given below summarizes the advantages and disadvantages of the above-mentioned four options under IPv4 and of using IPv6. Any of the IPv4-applied methods may work as a temporary solution but will invite a complication of the network. With the future taken into consideration, therefore, IPv4 has a fear of restricting the extensibility of the network in the future. IPv6, on the other hand, allows for a simple network setup and it might well be considered showing a high potential for growth in the future.

A Comparison of IPv4 with IPv6

Advantages and Disadvantages of IPv4- and IPv6-applied Networks

	METHOD	ADVANTAGE	DISADVATAGE
IPv4	NAT	Easy and inexpensive to introduced by installing NAT equipment or by letting a router perform the NAT functions.	Too difficult to grasp a network status ahead NAT, resulting in failure to manage the network in a centralized manner. Some applications may be unserviceable. Objects to be operated will increase.
	Renumber	Reconfiguring the network will permit a more readily manageable network to be set up.	It will necessary to review the network, being followed by re-setting and deployment operations. Cost involved will incur. There are possibilities that the network may be required to be reviewed all over again, though dependent upon an application to be introduced in the future.
	Net mask change	A phenomenon would take place as if renumbering were done.	
	Secondary address	A phenomenon will take place as if NAT were implemented.	
IPv6	Address acquisition	Addresses may have their possible runout coped with while making the network scalable. A simple network may be set up.	It is necessary to set up a IPv6-applicable network. At present, some unserviceable applications are existing.

IPv4 may be used to set up the network as a stopgap. It would never fail to get bogged down. Besides, there is a fear that the setup cost may continue to incur.
Making the network applicable to IPv6, however, permits us to assume that a future bog-down will take place less frequently than that with IPv4.

What need be taken in consideration for security in IPv6

To set up a company network with IPv6, however, it is necessary to take security into full prior consideration. It involves some aspects that may require principles different from those under IPv4 and new measures. The IPv6 network should take security measures, with the following points taken into account:

Firewall （enterprise boundary firewall）

The firewall located on the boundary between Internet and an in-house network should be, in principle, operated in accordance with the following policy:

- IPv6 routing is allowed between DMZ and Internet.
- IPv6 routing is allowed between DMZ and an in-house network.
- IPv6 routing is not allowed between an in-house network and Internet.

Stepping-stone protection （Intra-DMZ server）

The server inside DMZ should have proxy prohibited so that it may be protected against becoming a stepping-stone for invasion of security.

Virus protection for servers in DMZ and in house

These servers are to have virus-scanning data established in the interior.

Illegal access protection in routers for in-house server segment

For IPv4, NAT（Static NAT for DNS） is to be established. As far as filtering is concerned, IPv6 SIP only is permitted in this segment.

Illegal access protection in departmental routers

Limiting IPv6 to a certain bandwidth is to be also taken into consideration.

Departmental firewall

The departmental level firewall is to be established for IPv4 as usual. For IPv6, on the other hand, the network is to select whether all communications or SIP/designated port number only be permitted.

General PC

For general in-house PC terminals, a personal firewall is to be introduced so that the permit of an SIP phone-related application will be selected. A virus is also to be scanned. To identify a terminal, an anonym is to be inhibited from being used as far as the IPv6 address management is concerned. An EUI-64-based address is to be used.

Coping with an Increase in Operational Cost and with a New Application

Out of the three major issues, the first one, or address collision/increase in number of terminals, has been already discussed. Now, how about the rest two issues, i.e. an increase in operational cost and a new application?

For operational cost, an expansion of the network would undeniably tend to complicate the network configuration. Trying to reduce the equipment to be managed, however, could suppress that trend to complicate. A reduction of NAT, in particular, will bring about a possibility of alleviating the management load.

For another issue or how to cope with an application, it may be safely pointed out that using global addresses while avoiding the use of private addresses as far as practicable would be advantageous to set up the network infrastructure capable of coping with a wider range of applications likely to be used in house from now on.

Miscellaneous Considerations

An increase in operational cost is essential to a change in network. The cost reduction is attempted by reducing the equipment to be operated. → **Operational cost is reduced by simplifying the network. Now, how to reduce?**

- Simplification requires a decrease in equipment to be managed. Extra equipment is not used.
- Equipment to be managed may be reduced by removing the NAT that has been used to set up a network on a patch-work basis.

Cope with an application to be introduced in the future (except for restrictions for the sake of security) → **Indispensably necessary to set up the network capable of coping with any application that may be implemented. Now, what network is required?**

- Network should be set up preferably with global addresses rather than private ones to cope with any application that may be introduced.

Comparing Cost to Set up VoIP between IPv4 and IPv6

As gathered from what has been referred to hereinabove, you will feel it better to set up VoIP with IPv6. Could an IPv6 setup, however, really reduce the cost?

Now, let's compare the cost between IPv4 and IPv6 on the assumption that Company B newly introduces VoIP.

Company B has already set up the IPv4 network equipped with about 125 units of core-system routers/switches and about 4,300 units of other routers/switches. To make use of IPv6, the equipment required to be made applicable to IPv6 includes approximately 125 units of core system routers and switches. The IPv4 network has been already set up but requires the setup cost for delivery of VoIP addresses. For SIP terminals, moreover, soft phones and hard phones should be distributed at a ratio of 1:1. To set up the VoIP with IPv4, it is necessary to provide the equipment capable of holding an SIP session (SIP-NAT) since the network is partially composed of NAT.

What is required for the initial cost to set up the network with VoIP mainly includes an SIP server, SIP-NAT with the IPv4 network set up, and SIP terminals (soft and hard phones).

As far as various setup expenses are concerned, the IPv4 network would require the cost to set up the VoIP network, SIP and SIP-NAT. A setup of the IPv6 network, on the other hand, would require the cost for a changeover of the network to IPv6 in addition to the expenses incurred on the IPv4 network.

For running cost, the equipment requires the cost for maintenance and operation monitoring on a component by component basis.

An actual estimate of the elements referred to above would result in a graph as given below.

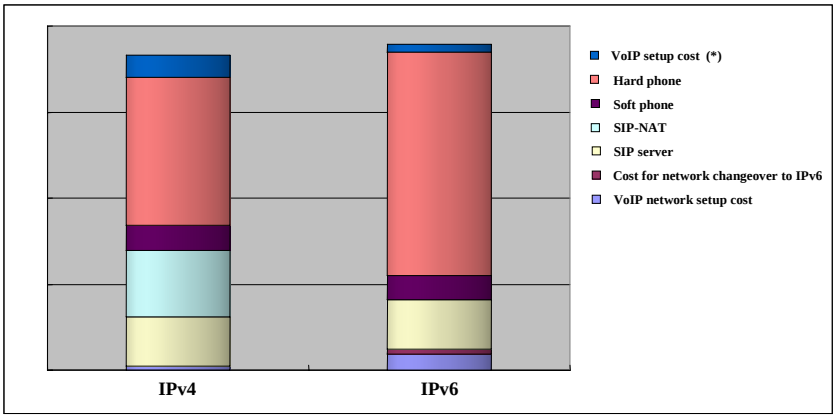
As far as the initial cost is concerned, the IPv6 network shows a significant increase in acquisition expenses as compared with the IPv4 because the former requires the cost for a changeover of the network to IPv6 while a limited number of hard phone models only are applicable to the IPv6. On the other hand, the IPv6 network would save the cost for purchasing the SIP-NAT.

As a conclusion, the IPv6 network requires a higher initial cost than the IPv4 but with little difference in cost. As far as the running cost is concerned, the IPv6 network is less costly because the SIP-NAT operation/maintenance cost is saved. Consequently, the estimate reported herein has led to the conclusion that the IPv6 network will achieve a lower total cost than that for the IPv4 within one year following the introduction.

Cost Comparison

Initial Cost

IPv4 is likely to require lower initial cost than that for IPv6. So large a difference, however, could not been seen .



(*) Cost to set up SIP server / IP-NAT

Running Cost

A difference between IPv4 and IPv6 would turn out to apply as cost for maintenance of SIP-NAT.

The case study reported herein would permit the cost to be recovered within one year.

Conclusion

Discussed in the case study reported hereinabove are those problems which a large enterprise with an existing network may encounter when introducing the application requiring to hold a session, such as VoIP, in their timing to update the network for various reasons.

Proceeding with the introduction of such application premised on the existing network would invite a variety of problems. An address duplication issue and an address assignment policy deadlock due to an increase in number of terminals may be taken up for exemplar problems.

In addition, an estimated cost comparison has been made between VoIPs set up with IPv4 and with IPv6. Both, however, has been found not to differ significantly on a cost basis.

Since undeniably the cost that the network operator could not see may incur, such cost

aspect might well be considered to vary with the company trying to introduce. Though this cost portion is most important, it has been excluded from the cost comparison reported herein because it would vary remarkably from case to case.

From the cost comparison referred to hereinabove, however, it may be safely gathered that there is no significant difference in cost between IPv4 and IPv6. Consequently, the deployment from an existing network to the IPv6 seems to raise no cost problem.

With the future networking trends taken into consideration, the deployment to IPv6 is likely to make unavoidable progress. It is considered necessary, therefore, to go on accumulating various verifications and setup estimations about a possible changeover to the IPv6 network even if an envisaged network should be small-sized.

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