Part VI: What are the advantages and disadvantages of migrating to IPv6?

The Internet Protocol, or IP is one of the pillars which supports the Internet. It is over 20 years old. It is a network-laer protocol for the Internet. In 1991, the IPv4 as the original version was called, was up for review as it had outlived its desing. The Next Generation IP, called IPng or IPv6 (version 6) was the result of a long drawn process and took almost three years to shape up.

The new version is designed to solve the problems that existed with IPv4. The differences between the two versions are in five main areas: Addressing and routing, Security, Network Address Translation, Administrative workload, and Support for Mobile Devices.

The IPv6 has been designed to enabled a structured and possible migration and transition plan. IPv4 uses 32-bit addresses, and with the growth of the Internet, IPv6 addresses move up to 128-bits. This means that the IP addresses will be longer, but the numbers will not get so scarce as the IPv4 has become. This will ensure that every IP device can have a unique address, whether its behind a firewall or not.

IPv4 and IPv6

*bit = binary digit

Internet Protocol version 4	Internet Protocol version 6
32-bit* number	128-bit* number
Dotted Decimal Notation:	Hexadecimal Notation:
192.0.2.0	2001:DB8::/32
4 billion network addresses	16 billion-billion network addresses

Advantages of the move to IPv6

The move to IPv6 will improve total connectivity, reliability and flexibility besides re-establishing transparency and end-to-end traffic across the Internet. It will also hopefully reduce the size and complexity of the global routing tables. It will also be possible to autoconfigure the systems . Thus network managers and administrators jobs will get a lot more easier.

Another major goal of the IPv6 is to speed up the network, both from a performance and from a deployment point of view. It embodies the lessons learned at trying to build high speed routers for IPv4 by changing the header of the IP packet to be more regular and streamline the work of routers moving packets across the Internet backbone.

This transition will mean that high-bandwidth multimedia can become seamless and streaming both audio and video content across the world will become an easy task. Multi-casting, a compulsory feature of IPv6, will become possible and easy. This essentially means that transmission of the single datagram to multiple recievers will be possible, although such possibilities also exist in the current IPv4 system, these are optional and not every router and host system supports them.

A very interesting feature of the IPv6 or goal is VPNs or virtual private networks. IPv6 builds in new IP Secuirty protocols; ESP (encapsulated security protocol) and AH (authentication header) as core featues. Thus IPv6 is expected to be capable of setting up far more secure and easier networks to build and deploy.

The migration plans stir up a hot debate

"In the international debates, developing countries should have a voice. I am happy to be able to represent this voice in the NRO (Number Resource Organisation) as an elected member from India on the NRO, from APNIC, one of the Regional Internet Registry, " says Naresh Ajwani, Secretary of ISPAI and a director of NIXI. The transition involves costs.

Paul Wilson, Director General of APNIC identifies some of the challenges: "A major challenge is the lack of business case for IPv6, because there is no immediate return on investment by ISPs in IPv6 deployment. IPv6 is designed to be a 'plug-in replacement' for IPv4 which means that there is no immediate difference to the Internet user, and hence no user demand. Without user demand this is no demand from ISPs, and thus little demand on equipment vendors for commercial grade IPv6 infrastructure products. As IPv4 address space is consumed over the next 2-3 years, this is expected to change rapidly, as service providers begin to plan and roll out services."

According to Geoff Huston, Chief Scientist at APNIC presenting the Internet Industry view at the recently held OECD conference in Seoul, "At present, only a small percentage of the Internet infrastructure supports IPv6. Significant investment in the infrastructure of the network is required to enable the transition from IPv4 to IPv6. The cost of migrating the Internet infrastructure to IPv6 is significant when considering the global scope of the task, but the cost of not making this investment will end

up being far higher. And, ultimately, it's the end user population who will have to bear this cost. The longer this investment in IPv6 deployment is deferred the greater the risk of costly fractures in the fabric of the network, and additional costs being incurred."

This meeting also claimed that 85% of the IPv4 numbers are already consumed.

The Advantage-Disadvantage debate is on!

There are advantages and disadvantages of the move from IPv4 to IPv6. Some people believe, that there is a hype being created about the need to compulsorily move to IPv6. " I believe for several decades, IPv4 and IPv6 will continue to co-exist, as they have since 1999. The developing countries cannot bear the costs of the transition. Though Asia has seen a vast growth in the numbers of IP being used, its important to learn transparently where are the 4 billion IP numbers in use" according to Naresh Ajwani.

According to some other estimates there is still one billion or so numbers available on the IPv4 platform. The question to ask about transition is: Who picks up the cost? Internet, as originally conceived, must be the biggest leveller of the world. There is need to develop infrastructure, applications or software, to support both versions. Smooth transition is still a big challenge.

The fact that IPv6 will allow individual consumer goods like mobiles, fridges microwaves, etc. to have their own IP, will not make the Personal Computers a redundant device.

Vijay Kapur, National Technology Officer, Microsoft India states, "Given our aspiration of using the Internet to be the engine of bring eGovernment to our billion strong population the address space that IPv6 makes available natively will be of crucial importance as we go about building our national network infrastructure. Also, as 'connectedness' becomes a way of life with the ability to connect becoming an integral part of a new generation of devices and household gadget, IPv6 is going to be a crucial enable for a whole new set of business and consumer scenarios. While the IPv4 address space is diminishing rapidly it hasn't yet become visible as the crisis it is becoming and so escapes attention. As it turns out, emerging economies like Africa, that have no legacy, seem to be taking the lead here. China, with it's larger Internet user-base is already feeling the pinch and so seems to be reacting a little more rapidly than us. From a people perspective I believe we have the requisite technical skills and resources. From a technology perspective, most of the new generation of software and network devices support IPv6. Microsoft has built in native support for IPv6 in Windows Vista and Windows Server 2008. However, the cost of migration does seem to be a very real barrier. So, in effect, our legacy base of equipment, which fortunately is not as large as that of the developed economies, sheer inertia and cost, may turnout to be out biggest challenges. We can't survive forever on NAT! I believe India has what it takes to be a global leader in IPv6 adoption and that we should just put our backs to it and get on with it! It will need concerted effort from all the stakeholders though and it would be great if the Government and Industry work together to catalyse this."

In India, the TRAI (Telecommunications Regulatory Authority of India) in August 2005 had issued a position paper to seek stakeholder feedback on the transition from IPv4 to IPv6.

The significance of its transition in e-Governance applications be mandated, and to ensure that procurement systems are put in place keeping the issues that this transition involves. NIXI is identified as the national test bed for IPv6, including guaranteeing a better quality of service to the clients/ end-users. ERNET has also set up a pilot testbed for IPv6 infrastructure transition.

Organisations like Sify in the private sector have already begun their technological readiness to IPv6.

According to Jitendra Shah, IPv4 and IPv6 are expected to co-exist for several years or decades and since IPv6 is not compatible to IPv4, there will be need to have dual IP stacks and need to be tunnelled through routers.

Some global examples and challenges faced

In the United States, by June 2008, all federal installations were to be migrated to IPv6 as per the plans made by US government. Yet the transition to IPv6 "capable" represents great new challenges for most network operators and security teams. In fact, some agencies have delayed their migration plans due to lack of necessary IPv6 compliant security devices. The following use cases profile key IPv6 challenges:

- IPv6 "Self-Propagating" Features Can Create Unknown Tunnels and Rogue Routing: With IPv6's self propagating features, IPv6 communications can occur with little configuration and without intent or oversight. Automatic tunnels that bypass controls and rogue routing can contribute to this likelihood. Network administrators must have the ability to detect both when tunnels are used as well as what actual connections/routes and destinations occur.
- Time and Effort Intensive Transition Management: Organizations may struggle to maintain availability of services while networks, hosts, servers and applications all migrate independently to IPv6. In addition, monitoring two parallel, interwoven networks will be a challenge for many network operations teams.
- Some new security risks, which are critical, associated with IPv6 include:
  - Difficulty in Enforcing Security Policy on IPv6 Flows
  - Limitations of Traditional Active Scanning
  - Increased Misconfigurations

In the Philippines, with support for a research study provided by International Development Research Centre, the National College of Public Administration and Governance, from the University of Philippines with UK's IDPM University of Manchester conducted a study in November 2003 on evaluating the impact of universal access models, strategies and policies in ICTs on poor communities in Philippines and and also explored the potential of IPv6 migration.

In preparation for the recently concluded Beijing Olympics, the Chinese government deployed IPv6 throughout the city of Beijing, and this ensured that fast access to Internet was available.

The IPv6 migration issues and debate is far from over. It will be an important issue being discussed at the upcoming Internet Governance Forum to be held in Hyderabad from December 3-6, 2008. For more details on the issues and agenda of the conference, please log on to *www.intgovforum.org*