

# IPv6 Implementation

## Case Study



# 1 Executive summary

In five months (February 2011 until July 2011) GN-IX has been gearing up and making itself ready to start and run IPv6 on its network. As part of an internship a student from the Hanze University of Groningen has been preparing the network core and servers of GN-IX so the transition will be smooth and without interruption to service. In the transition period to IPv6, IPv4 will function next to IPv6 in a so-called Dual-Stack network. This way GN-IX and its customers will be able to enjoy and use the full connectivity to the internet.

# 2 Problem statement

Thirty years after the invention of the Internet protocol version 4 as a way to give everything on the World Wide Web an address, the world has to make itself ready for a large change in the way we go online. Due to the growth in the use of Internet and the large number of PCs, Laptops, PDA's, mobile phones, websites, virtualized servers, cars and even appliances like refrigerators and washing machines being online, the world doesn't have enough IP addresses left. On the second of February 2011 the International Assigned Numbers Agency (IANA) assigned the last of the IPv4 address blocks to the Regional Internet Registrars (RIR's), officially starting the transition to IPv6. In the coming weeks and months the world will slowly transition to IPv6. With more addresses than there are stars in the whole Universe ( $3.8 \times 10^{38}$ ), it is estimated that for the coming 70 to 100 years we will have enough addresses to go around.

As regional internet exchange it is very important for GN-IX to be prepared for all the future changes and developments on the World Wide Web. Due to the fact that some companies in the near future will only be able to connect via IPv6, GN-IX's customers expect them to be up to date and to be able to deliver the most recent products on the internet.

# 3 Alternatives

In this case there is no alternative except for IPv6. There is an option to wait, but then in the future there will always be a moment to switch from IPv4 to IPv6. For the period of transition there are three alternatives:

1. NAT64

This mechanism arranges the possibility for communication between IPv6 and IPv4 servers/hosts. An IPv6 host translates an IPv4 address into an IPv6 address and sends this to the router. The router then makes the translation to IPv4 and arranges the rest of packet handling. This solution works closely together with DNS64.

2. NAT-PT

This is the earlier solution of NAT64. Because there was no scalability and there were mistakes made in the design of this solution, this solution soon became deprecated. Also the IETF (Internet Engineering Task Force) soon declared this as obsolete.

### 3. Dual-Stack

This is the most simple form of transition. Basically there are two networks, one for the IPv4 traffic and one for the IPv6 traffic. The IPv6 protocol is preferred above IPv4 unless there is no possibility of using this. In the first period there is not a lot of traffic over IPv6, but when the internet IPv6 traffic grows, there will be a movement from IPv4 to IPv6. When the whole Internet is using IPv6, IPv4 can be shutdown.

## 4 Conclusion

The ideal situation is to migrate everything to IPv6, so there will be less maintenance needed and there is standardization in IP-addressing. At the office there was the problem that not all of the machines were IPv6 ready, since there are all kinds of machines like printers, faxes, phones, computers and servers. This is the reason that not everything can run on IPv6.

NAT-64 is a good solution, but the current used routers (Cisco 7201) does not support this solution. Another option was to run a virtual router on Linux with an open source NAT-64 solution, but during the tests this seems to be unreliable and instable.

NAT-PT was another real solution. The advantages were that the whole office could run IPv6 and the rest of the network in a Dual-Stack solution, because some applications and websites needed to be available on IPv4. Also the office had a native IPv6 connection, which will cause less maintenance in the near future. But after some more research and testing this option seems to be hardly used and needed a close cooperation with DNS. This made the solution really complex and unreliable. Besides that it cost the router a lot of capacity to translate all the packages from IPv4 to IPv6 and for every address in the network there was a static route needed to make it known on the internet.

Finally the best solution seemed to use IPv4 as well as IPv6 on the entire network, the so-called Dual-Stack solution.

## 5 Implementation

Since there was chosen for the Dual-stack implementation, there had to be added a new IPv6 network above the current running IPv4 network. Before the implementation started, the following things had to be arranged:

- A well tested solution
- An IPv6 numbering scheme
- If necessary: updates for the servers for IPv6 support
- New AAAA DNS records
- As little as possible moments of downtime

After these steps the implementation plan had to be designed. Before the servers were migrated, first the network had to be made ready for IPv6, by implementing the following steps:

- Configure the IPv6 VLANs on the switches from GN-IX for Dual-Stack (layer 2)

- Configure the IPv6 subnets on the routers from GN-IX (layer 3)
- Investigate all ACL's, firewalls, IP filters and add the IPv6 equivalent to the configurations
- Optional: Configure the IPv6 addresses for network management, therefore some of the network devices need to be upgraded to the newest IOS for IPv6 support.
- Optional: Make the configuration for IPv6 peers on the routers and route-servers.

Globally these parts where necessary for migrating the servers to IPv6:

- Schedule downtime for the applications
- Configure an extra network interface for the IPv6 network. One for IPv4 and one for IPv6.
- Making the new interface and firewall settings for the virtual server for IPv6.
- Update all applications for IPv6 support
- Changing the settings of the running application on the server to make it IPv6 ready, or if necessary, restart the application.
- Change the DNS settings, so in this case the whole Internet can have the application available on IPv6.

When all these steps are finished there is Dual-Stack network running in the organization!

## 6 Participants

