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Report #3

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Abstract

With the beginning of the Internet age, and the growth of number of devices connected to it, it was clear that the addressing space given by the IPv4 standard is just not gonna be enough! As a replacement protocol for IPv4, IPv6 was formalized, by the Internet Engineering Task Force, in 1998. In this experiment we discuss IPv6 briefly, and how it can be configured in CISCO routers.

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Part I
Introduction

1 Why the move to IPv6?

In our modern day networking technologies, we identify connected devices by a unique address, which we use to communicate between said devices. The addressing used is achieved by the Internet Protocol v4, IPv4 for short, which can offer up to 2^{23} unique addresses, which was, even though all of the clever tricks of increasing the usable space such as NATs, far exceeded in February of 2011[1]!

Instead of using a 32 bit wide address as in IPv4, IPv6 increases the width of the address to 128 bits, giving us healthy address space of 2^{128} addresses. IPv6 also offers a lot of new features and improvements over the older protocol, IPv4, which it was designed to replace. IPv6 isn't designd to be interoperable with IPv4; however, several IPv6 transition mechanisms have been devised to permit communication between IPv4 and IPv6 hosts[2].

2 Benefits and Features

Aside from the much larger address spaces, IPv6 provides other technical benefits. Some of the main added features of IPv6 include hierarchical address allocation methods that facilitate route aggregation across the Internet, and thus limit the expansion of routing tables. The use of multicast addressing is expanded and simplified, and provides additional optimization for the delivery of services. Device mobility, security, and configuration aspects have been considered in the design of the protocol[2].

2.1 Addresses in IPv6

IPv6 uses 128 bits to assign addresses, composed of 8 groups, each of four digit long hexadecimal number, separated by colons. Leading zeros can be omitted from each group, and a sequence of zeros can be omitted in favour of a '::' symbolizing multiple, implicit, groups of zeros. One note on the abbreviations of IPv6 addresses is that the double colon, '::', method of abbreviating the addresses is only allowed to be used once per address, as more of it can make the address ambiguous[2].

For example the IPv6 address '$2001 : 0db8 : 0000 : 0000 : 0000 : 8a2e : 0370 : 7334$', can be abbreviated as either '$2001 : 0db8 : 0 : 0 : 0 : 8a2e : 0370 : 7334$' or as '$2001 : 0db8 :: 8a2e : 0370 : 7334$'.

2.2 Address Types

Unicast
: packets transmitted to a Unicast address are delivered to a single interface.

Global Unicast Addresses
: are like public addresses in IPv4, and can be addressable by any device on the IPv6 Internet.

Link-Local Addresses
: are like private addresses in IPv4, they aren't meant to be routed from outside a network.

Multicast
: the same as in IPv4, packets are delivered to all interfaces tuned to the Multicast address.

Anycast
: it is like a Multicast address, except that it delivers the packets to one interface, the closest to the sender in terms of routing distance.

Part II
Procedure

The network simulated is as follows in figure 1.

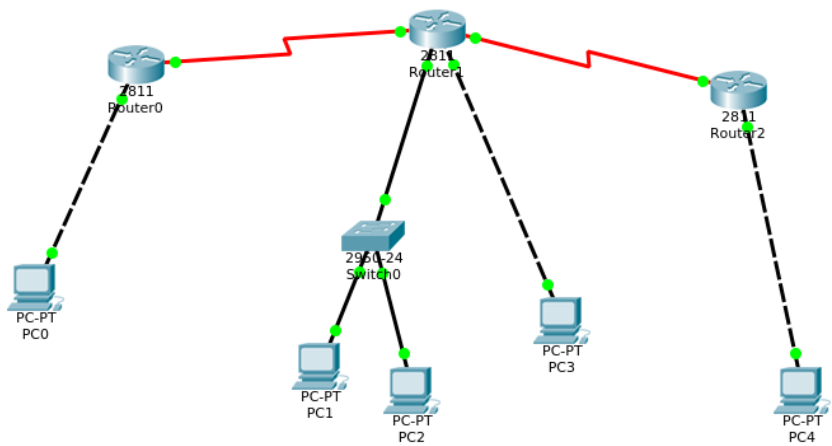

Figure 1: The topology simulated in this experiment.

The IP addresses are distributed as shown in the following table

Device	Address
PC0	2001:AA11::2/64
PC1	2001:AA22::2/64
PC2	2001:AA22::3/64
PC3	2001:AA33::2/64
PC4	2001:AA44::2/64
Router0 – PC0	2001:AA22::1/64
Router0 – Router1	2001:AA55::1/64
Router1 – Switch	2001:AA22::1/64
Router0 – PC3	2001:AA33::1/64
Router1 – Router2	2001:AA66::1/64
Router1 – Router0	2001:AA55::2/64
Router2 – PC4	2001:AA44::1/64
Router2 – Router1	2001:AA66::2/64

Routers' address assignment was achieved by applying the following command 'ipv6 address ¡IPv6 Address¿/¡prefix number¿', on each of the needed interfaces.

For the following, were we demonstrate routing between the devices in the topology, the command 'ipv6 unicast-routing' needs to be issued first, to enable IPv6 routing on the routers.

To enable static routing we use the command 'ipv6 route ¡IPv6 source¿/¡prefix¿ ¡ipv6 destination¿/¡prefix¿'. But in this experiment we primarily simulated RIP on IPv6, which is almost identical to RIP in IPv4. To configure RIP we use the following command 'ipv6 rip ¡id¿ enable', ¡id¿ can either be a number or a name to identify the RIP instance, the router handles the rest of the configurations on it's own.

Figure 2 shows the successful ping messages between the devices in the network.

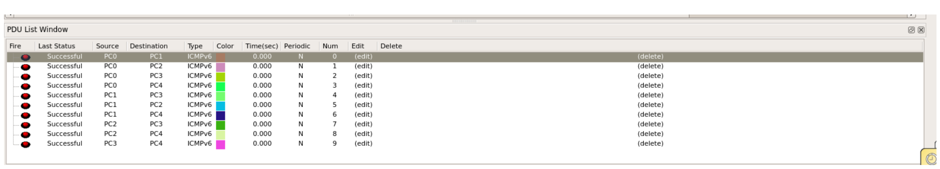

Figure 2: The successful ping requests after configuring the topology.

Part III
Conclusions

In this experiment we discussed, briefly, the new IPv6 internet standard, and how it aims to fix IPv4's address exhaustion. IPv6 creates an enormous address space, along with a better technical design than IPv4, for use in our ever expanding connected world. Practically, we simulated a small network and ran it using IPv6 addressing, using CISCO's PacketTracer software.

References

[1] Wikipedia. *IPv4*. May 2016. URL: https://en.wikipedia.org/wiki/IPv4 (cit. on p. 1).

[2] Wikipedia. *IPv6*. May 2016. URL: https://en.wikipedia.org/wiki/IPv6 (cit. on pp. 1, 2).

[3] Microsoft. *Unicast IPv6 addresses*. May 2016. URL: https://technet.microsoft.com/en-us/library/cc759208(v=ws.10).aspx.

[4] *Experiments Manual*.