CSE 4512 [Computer Networks Lab]

Lab # 04

1. Objectives:

- Describe the concept of IPv6
- Configure IPv6 addressing scheme in a network topology

2. Theory:

As with other labs, this lab will also build up on the concepts and techniques of previous labs. So, make sure you've properly understood the previous lab contents.

IPv6:

Internet Protocol version 6 or IPv6 is the successor to IPv4 or Internet Protocol version 4. In nineties, it became evident that IPv4 can't accommodate the explosion of connected devices in the internet. Theoretically, IPv4 can support 2^{32} unique addresses whereas IPv6 can support 2^{128} addresses as an IPv6 address uses 128 bits. Though the actual number is less than that due to some reserved address ranges but still the available address space is deemed large enough for the foreseeable future.

Like its IPv4 counterpart, an IPv6 address also has two portions: *Network Identifier* (most significant 64-bit) and *Interface Identifier* (least significant 64-bit). Note that, this division into two parts is only valid for IPv6 unicast and anycast address, not for multicast address. The network identifier or network prefix is used for routing and interface identifier works the same as the host identifier of IPv4.

An IPv6 address is represented as *eight* groups of *four* hexadecimal digits, where each group is 16 bits in length (as a single hex digit is 4-bits wide). Considering IPv4 terminology, each group is formed of two octets. The groups are separated by colons (:). An example IPv6 address is:

2001:0db8:85a3:0000:0000:8a2e:0370:7334

To keep the representation of an IPv6 address concise, two rules are followed.

- If there are one or more leading zeros in a group, those are removed. For example, the group 0069 will become 69.
- Consecutive groups of zeros are replaced with a double colon (::). This can only be used once in an address, as using double colon multiple times would make the address indeterminate.

Lets see these rules in action on an example IPv6 address.

Initial address: ***2001:0db8:0000:0000:0000:ff00:0042:8329***

After removing all leading zeros in each group: ***2001:db8:0:0:0:ff00:42:8329***

After omitting consecutive sections of zeros: ***2001:db8::ff00:42:8329***

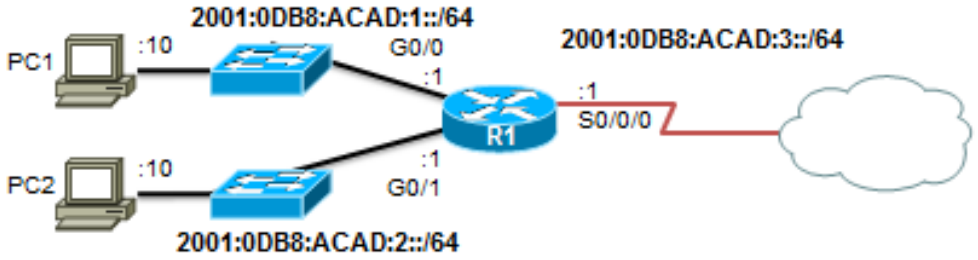
An extreme example of these two rules can be seen in the IPv6 loopback address. The loopback address in IPv6 is *0000:0000:0000:0000:0000:0000:0000:0001*, which after applying the above two rules becomes *::1*. Pretty concise, right?

Unlike IPv4, there's a special address called link-local address which has to be assigned on every IPv6 enabled interface. So, each IPv6 hosts usually has more than one IPv6 address assigned to each of their IPv6 enabled interface. The name link-local comes from the fact that this address is only valid for communicating within the network segment or the broadcast domain of the connected host. The link-local address of the router is used as the default gateway for the connected hosts. Link-local address is also used as part of the neighbor discovery protocol and automatic address configuration. Link-local address uses the prefix *fe80::/10*. Of the 64 bits of a link-local addresses' network component, the most significant 10 bits (*1111111010*) correspond to the IANA-reserved "global routing prefix" for link-local addresses, while the "subnet ID" (the remaining 54 bits) is *zero*. Rest 64-bits are used as interface identifier.

3. Configure IPv6 addressing:

In this section, we'll configure IPv6 addressing in the given network topology.

I. Command *IPv6 unicast routing* enables IPv6 routing**.** Execute this command in the privileged EXEC mode of the router.
II. Assign IPv6 addresses in the router interfaces using the following commands.



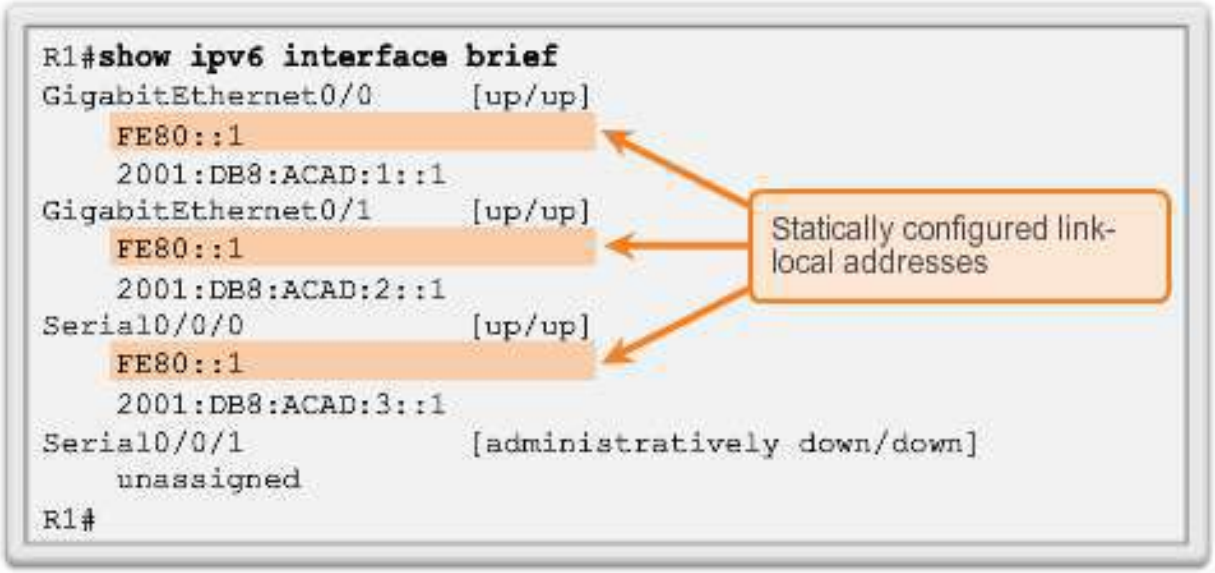

```
R1(config)#interface gigabitethernet 0/0
R1(config-if)#ipv6 address 2001:db8:acad:1::1/64
R1(config-if)#no shutdown
R1(config-if)#exit
R1(config)#interface gigabitethernet 0/1
R1(config-if)#ipv6 address 2001:db8:acad:2::1/64
R1(config-if)#no shutdown
R1(config-if)#exit
R1(config)#interface serial 0/0/0
R1(config-if)#ipv6 address 2001:db8:acad:3::1/64
R1(config-if)#clock rate 56000
R1(config-if)#no shutdown
```

III. Assign link-local addresses to the router interfaces.

```
R1(config)#interface gigabitethernet 0/0
R1(config-if)#ipv6 address fe80::1 ?
  link-local  Use link-local address

R1(config-if)#ipv6 address fe80::1 link-local
R1(config-if)#exit
R1(config)#interface gigabitethernet 0/1
R1(config-if)#ipv6 address fe80::1 link-local
R1(config-if)#exit
R1(config)#interface serial 0/0/0
R1(config-if)#ipv6 address fe80::1 link-local
R1(config-if)#
```

IV. Verify addressing.



4. Tasks:

I. You will implement IPv6 addressing scheme following the address configurations in a given network topology in this task. The task description for this task is provided in the pdf ***Task-1_configure-ipv6-addressing***. You're provided a .pka file for this task.

II. You'll do the **Part 3** of the task provided in ***Task-2_configure-layer-3-switching-and-inter-vlan-routing*** that was omitted before in Lab-3. You'll configure the IPv6 addressing on top of your solution of Task 2 of Lab 3 following the instructions in Part 3.