IPv6 on routers

Computer Network Technologies and Services (CNTS)
Tecnologie e Servizi di Rete (TSR)

Preliminary note

For this exercise you have to use the virtual routing environment prepared in a virtual machine.

The *GNS3* VM instructions can be found at this URL: `http://netgroup.ipv6.polito.it/images/Didattica/CNTS-TSR_slide/GNS3_lab_intro.pdf`

Note: In case you want to work on the lab experience not in LADISPE, you can use a similar network emulator with a web-based interface that is called Dyn@NG. Instructions on how to access it can be found at `http://netgroup.polito.it/images/Didattica/CNTS-TSR_slide/Dynng-Tutorial.pdf`

1 Network topology and base configuration

First of all, you should recreate the network topology depicted in Figure 1 using the GNS3 interface.

The objective of this experience is to understand the IPv6 router configuration mechanism and in particular how to enable IPv6 Routing and configure IPv6 Addressing on an IPv6 device.

Let us suppose you are the network administrator of the network in Figure 1 and, after requesting a class of IPv6 global unicast addresses, IANA assigned you the following prefix:

```
2001:1000::/56
```

As a prerequisite for the network to operate properly, an addressing plan shall be designed and addresses assigned to the router interfaces so that all routers can reach each other. In addition, it is required that router R1 must not have a manually configured IPv6 address; it has to be automatically configured through the Router Advertisement/Solicitation procedure.

1.1 Enable IPv6 protocol

When switched on the first time, the routers used in the lab do not have IPv6 addresses and IPv6 routing enabled.

To use IPv6 on a router, you must, at a minimum, enable the protocol. You can do it using the following commands:

```
enable
 configure terminal
  ipv6 unicast-routing
```

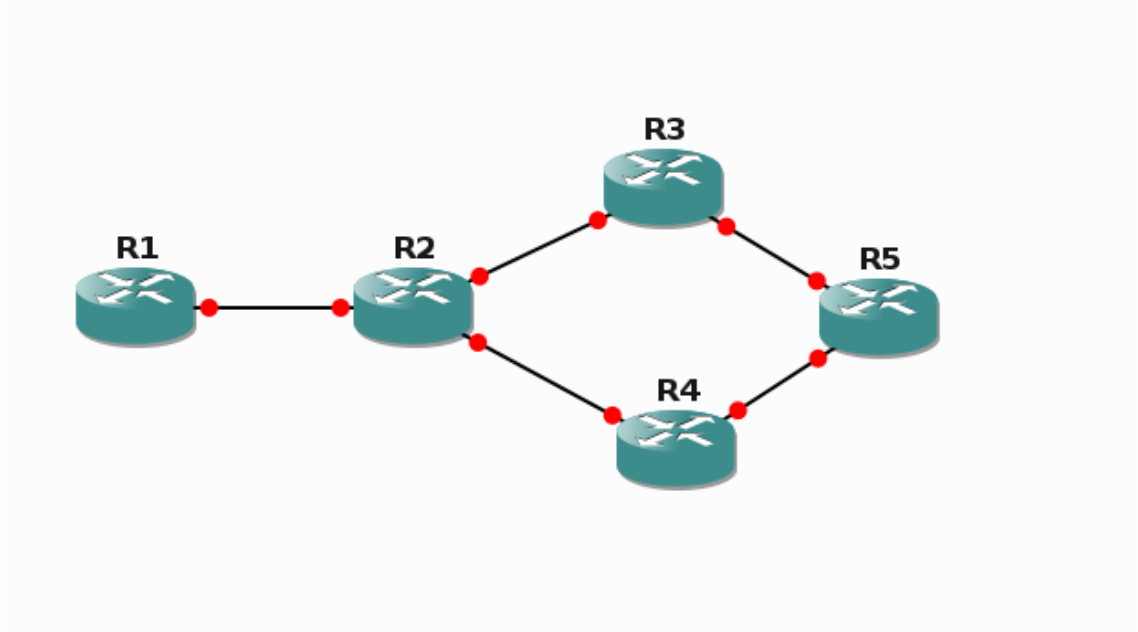

Figure 1: Network topology

The *ipv6 unicast-routing* command globally enables IPv6 and must be the first IPv6 command executed on the router, before being able to configure any aspect related to IPv6.

1.2 Configuring IPv6 Address

To assign IPv6 addresses to individual device interfaces you can use the *ipv6 address* command as shown below:

```
configure terminal
 interface <fastEthernet0/0>
  ipv6 address <ipv6_address/prefix_length>
  no shutdown
  end
```

This command manually assigns an IPv6 address to the specified interface. However, if you want to use the IPv6 Stateless Autoconfiguration you use the following command:

```
configure terminal
 interface <fastEthernet0/0>
  ipv6 address <autoconfig>
  no shutdown
  end
```

This will force the router to automatically configure a global IPv6 addresses by appending its interface identifier (64 bits) to the prefixes (64 bits) included in RA messages received through the interface.

Tip: You can use the *show ipv6 interface* command to verify an interface configuration:

```
show ipv6 interface <fastEthernet0/0>
```

Tip 2: You can remove a previously assigned IPv6 address from an interface with the following command:

```
no ipv6 address <ipv6_address/prefix_length>
```

Tip 3: When using FastEthernet1/X interfaces, please keep in mind that these are switched interfaces: they are like interfaces of a switch connected to the router[1]. They cannot be configured like regular router interfaces: it is necessary, in fact, to assign each switched interface to a VLAN and then to configure the resulting "VLAN interface" (consult the Cisco router configuration documentation for more details) as a regular router interface[2]. For example:

```
configure terminal
 interface <FastEthernet1/0>
  switchport access vlan <1>
  no ip address
  no shutdown
  exit

 interface <Vlan1>
  ipv6 address <ipv6_address/prefix_length>
  end
```

1.3 Routing in IPv6

1.3.1 Static Routing

IPv6 routers forward packets based on information they have in their routing table. As in IPv4, IPv6 routers look for the longest matching prefix in the IPv6 routing table to forward a packet to its destination. The main difference is that the IPv6 router is looking at 128 bits when making a routing decision instead of 32 bits. In case of multiple entries for the same prefix, routers use the best one based on a metric and/or an administrative distance.

Configure routes in each router so that any interface of all routers can be reached from any other router.

To define the next hop for a destination (i.e., a prefix) you can use the *ipv6 route* command as shown below:

```
enable
 configure terminal
  ipv6 route <ipv6_address/prefix_length nexthop>
```

[1]Although not strictly necessary for being able to execute this lab experience, more information on switched interfaces and their configuration can be found at `https://www.cisco.com/c/en/us/td/docs/switches/lan/catalyst2950/software/release/12-1_11_yj4/configuration/guide/lrescg/swint.pdf`

[2]Although not strictly necessary for being able to execute this lab experience, more information on VLANs VIrtual LANs) and their configuration can be found at `https://www.cisco.com/c/en/us/td/docs/switches/lan/catalyst2950/software/release/12-1_11_yj4/configuration/guide/lrescg/swvlan.pdf#M9.31101.ChapTitle.Creating.and.Maintaining.VLANs`

Tip: Cisco routers support `unnumbered` interfaces (i.e., interfaces without an IP address), in which case it is possible to use the name of an interface in place of the IP address for the next hop.

Tip 2: The default route is denoted as *::/0*

Tip 3: You can list the IPv6 routing table entries using the command:

```
show ipv6 route
```

1.4 Verification of proper operation

In order to verify that the routing configuration works, you can run a `ping` command from router R1 to one of the two interfaces of router R5.

Answer the Following Questions

Reminder. You will not get any evaluation for your responses. The aim of the proposed questions is to allow you to autonomously verify your understanding of the given topics.

1. Write the network prefixes selected for each link and the IPv6 addresses assigned to each router interface.

Prefix LAN R1 - R2	
R2 Fa0/0	
Prefix LAN R2 - R3	
R2 Fa0/1	
R3 Fa0/0	
Prefix LAN R2 - R4	
R2 Fa1/0	
R4 Fa0/0	
Prefix LAN R3 - R5	
R3 Fa0/1	
R5 Fa0/0	
Prefix LAN R4 - R5	
R4 Fa0/1	
R5 Fa0/1	

2. Write the static routes configured on each router.

Router R1

Prefix	IPv6 Next Hop

Router R2

Prefix	IPv6 Next Hop

Router R3

Prefix	IPv6 Next Hop

Router R4

Prefix	IPv6 Next Hop

Router R5

Prefix	IPv6 Next Hop

3. Write the IPv6 global unicast address auto-configured on the interface `Fa 0/0` of router R1.

R1 Fa 0/0	

4. Capture, analyze and briefly describe the operating principles of the auto-configuration procedure of the IPv6 address (Router Advertisement/Router Solicitation)

5. Capture the traffic generated when a ping command from R1 to R5 is executed; briefly describe the operating principles of the neighbor solicitation procedure related to the MAC address discovery.