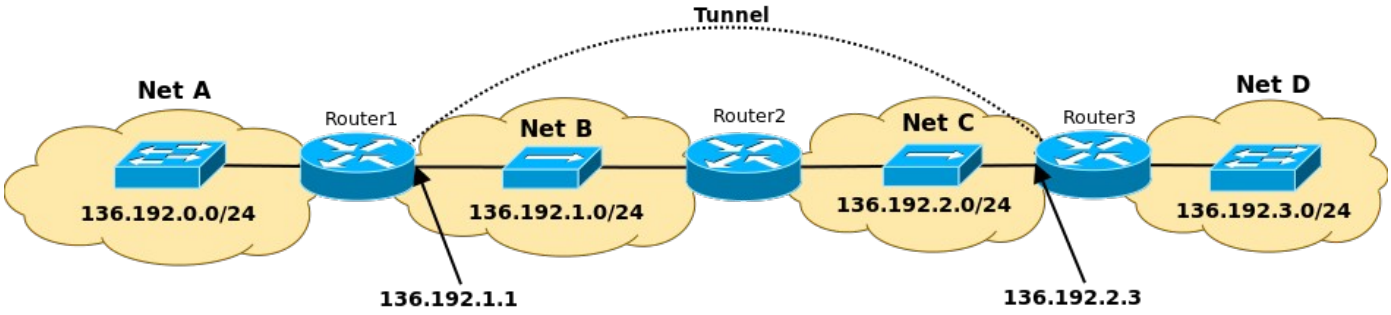
Arquitetura de Redes

Laboratory Guide

Objectives

- IPv4 Tunnels.
- Study of the IPv6 protocol.
  - Basic mechanisms.
  - Addressing.
  - IPv4 to IPv6 transition approaches and mechanisms.

IPv4 Tunnels



1. Assemble the above depicted network, start by configuring the IPv4 addresses of all interfaces and the RIP protocol in all routers. Verify the interfaces' configurations and the IPv4 routing table.

2. Configure an IPv4-IPv4 tunnel between Router1 and Router3 (as depicted in figure):

```
Router1(config)# interface Tunnel 0     !Tunnels can be numbered from 0 to 2147483647
Router1(config-if)# tunnel source 136.192.1.1
Router1(config-if)# tunnel destination 136.192.2.3
Router1(config-if)# tunnel mode ipip
…
Router3(config)# interface Tunnel 0
Router3(config-if)# tunnel source 136.192.2.13
Router3(config-if)# tunnel destination 136.192.1.1
Router3(config-if)# tunnel mode ipip
```

Check the status of Tunnel 0 on both routers:

```
show interface Tunnel 0
```

3. Configure a static route from Router1 to network 136.192.3.0/24 via Tunnel 0 (via tunnel destination IP):

```
Router1(config)# ip route 136.192.3.0 255.255.255.0 Tunnel 0 136.192.2.3
```

Verify the routing table.
Note: The Tunnel interfaces (as any Layer3 interface) require an IP address.

4. Associate the network 10.1.1.0/30 to the Tunnel and configure the IPv4 addresses of the end-points:

```
Router1(config)# interface Tunnel 0
Router1(config-if)# ip address 10.1.1.1 255.255.255.252
…
Router3(config)# interface Tunnel 0
Router3(config-if)# ip address 10.1.1.2 255.255.255.252
```

Verify the routing table and (if the static route is active) start a capture on Network B and perform a ping from the Router1 interface with network 136.192.0.0/24 to the Router3 interface with network 136.192.3.0/24.

(Example): `Router1# ping 136.192.3.x source 136.192.0.1`

Analyze the captured packets.

5. Tunnel interfaces don't need to have specific IP addresses, they can reuse the physical interfaces IP addresses:

```
Router1(config)# interface Tunnel 0
Router1(config-if)# no ip address 10.1.1.1 255.255.255.252
Router1(config-if)# ip unnumbered FastEthernet0/0
```

Verify the routing table and (if the static route is active) start a capture on Network B and perform a ping from the Router1 interface with network 136.192.0.0/24 to the Router3 interface with network 136.192.3.0/24. Analyze the captured packets.

6. Change th Tunnel e type to GRE IPv4:

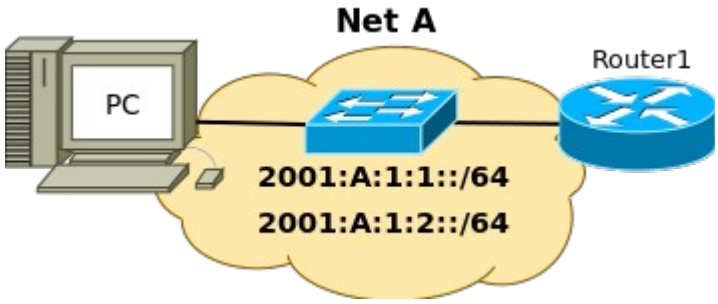
```
Router1(config)# interface Tunnel 0
Router1(config-if)# tunnel mode gre ip
```

Verify the routing table and (if the static route is active) start a capture on Network B and perform a ping from the Router1 interface with network 136.192.0.0/24 to the Router3 interface with network 136.192.3.0/24. Analyze the captured packets.

Note: The GRE IP tunnel allows multicast traffic, therefore the RIP updates are now being sent also by the tunnel interfaces. To avoid routing loops (tunnel requires knowledge of destination, destination is learned by RIP, destination is learned via tunnel), turn the tunnel interfaces into passive:

```
Router1(config)# router rip
Router1(config-router)# passive-interface Tunnel 0
```

IPv6 Basic Mechanisms



7. Considering the above depicted network, start by connecting the PC (running Linux) to the switch without any other connections. To avoid incompatibilities, disable the Linux network manager:

```
sudo service network-manager stop
```

Use `sudo service network-manager start` to restart the application/service.
With Wireshark, start a capture on device Pseudo-any (all interfaces) in non-promiscuous mode. Turn off and on the PC's Ethernet interface:

```
sudo ifconfig eth0 down
sudo ifconfig eth0 up
```

Stop the capture and analyze the IPv6 packets.

8. Connect Router1 to the switch and with Wireshark (at the PC) start a capture on device Pseudo-any (all interfaces) in non-promiscuous mode. Power on Router1 and configure its interface to network A.

```
Router1(config)# ipv6 unicast-routing
Router1(config)# interface <if-name>
Router1(config-if)# ipv6 enable
Router1(config-if)# no shutdown
```

Verify the IPv6 configuration of the router interfaces:

```
Router1# show ipv6 interface
Router1# show ipv6 interface brief
```

Restart the PC ethernet interface and verify its information:

```
sudo ifconfig eth0 down                (sudo ifconfig eth1 down)
sudo ifconfig eth0 up                  (sudo ifconfig eth1 up)
ifconfig eth0                          (ifconfig eth1)
```

Stop the capture and analyze the IPv6 packets and equipments information. Use the command (`show ipv6 interface brief`) to verify the interfaces' IPv6 addressing and the command (`show ipv6 route`) to verify the router IPv6 routing table.

9. With Wireshark (at the PC) restart a capture on PC's Ethernet interface (device eth0 or eth1) in promiscuous mode. Configure the Router interface with an IPv6 anycast address:

```
Router1(config)# interface <if-name>
Router1(config-if)# ipv6 address 2001:A:<#group>:2::/64 anycast
                #(in older models: ipv6 address 2001:A:<#group>:2::/64 )
Router1(config-if)# no shutdown
```

Verify the information of the PC Ethernet interface. Stop the capture and analyze the IPv6 packets. Verify the IPv6 addresses of the Router interfaces and the router IPv6 routing table.

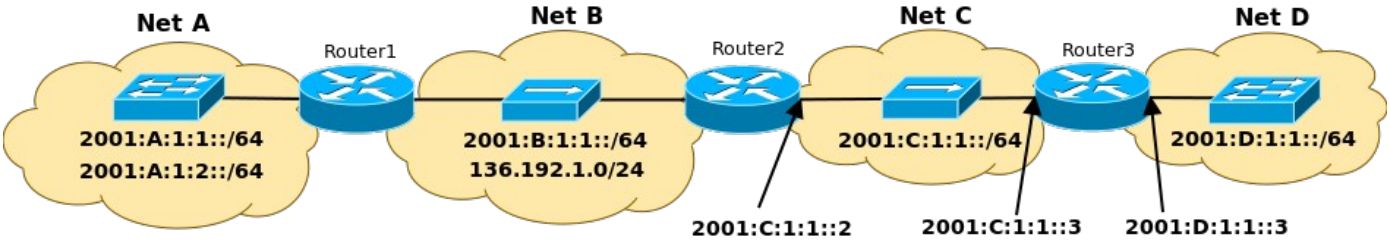
10 With Wireshark (at the PC) restart a capture on device eth0 (PC's Ethernet interface) in promiscuous mode. Configure the Router interface with an IPv6 global address and IPv6 network prefix:

```
Router1(config)# interface <if-name>
Router1(config-if)# ipv6 address 2001:A:<#group>:1::/64 eui-64
        #(or Router1(config-if)# ipv6 address 2001:A:<#group>:1::<n>/64 )
Router1(config-if)# no shutdown
```

Verify the information of the PC Ethernet interface. Stop the capture and analyze the IPv6 packets. Verify the IPv6 addressing of the Router interfaces and the router IPv6 routing table

11. With Wireshark (at the PC) restart a capture on the PC Ethernet interface (device eth0 or eth1) in promiscuous mode. At the PC, using the command *ping6* perform a ping to:
a) Router's Link-Local address (you need to define the output interface with option "-I eth0" or "-I eth1").
b) Router's Anycast address.
c) Router's Global address.
Stop the capture and analyze the IPv6/ICMPv6 packets.

Static Routing



12. Assemble the above depicted network, start by configuring the IPv6 and IPv4 addresses of all interfaces. Verify the interfaces' configurations, routing tables, IPv6 neighbors and running IPv6 protocols:

```
Router1# show ipv6 interface brief
Router1# show ipv6 route
Router1# show ipv6 neighbors
Router1# show ipv6 protocols
```

Execute multiple ping commands to test the connectivity between the equipments.

13. Configure all necessary static routes to achieve full IPv6 connectivity:

```
Router1(config)# ipv6 route <ipv6-net> <ipv6_next_hop>
```

Reverify the routing tables and retest the connectivity between the equipments.

IPv6 Tunneling

14. **Remove the IPv6 addresses from the Ethernet interfaces connected to network B**. Configure in Router1 and Router2 a manual IPv6 overlay tunnel:

```
Router1(config)# interface Tunnel1
Router1(config-if)# ipv6 address 2001:B:100:1::1/64
Router1(config-if)# tunnel source <if-name>
Router1(config-if)# tunnel destination <ipv4-address>
Router1(config-if)# tunnel mode ipv6ip
```

Make a similar configuration in Router2. Reverify the routing tables and retest the connectivity between the equipments.

15. Restart a capture on Net B. From Router2 ping Router1's network B IPv6 address. Analyze the captured packets.

16. Restart a capture on Net B. Execute all necessary static routing configurations in order to obtain full connectivity. From Router2 ping Router1's interface to network A. Analyze the captured packets.

17. Restart a capture on Net C. From Router1, ping Router3's interface to network C. Analyze the captured packets.

18. Reconfigure in Router1 and Router2 the tunnel to GRE over IPv4 mode to transport IPv6 traffic:

```
Router(config-if)# tunnel mode gre ip
```

Restart a capture on Net B. If necessary, execute all necessary static routing configurations in order to obtain full connectivity. From Router2 ping Router1's interface to network A. Analyze the captured packets.

19. Reconfigure in Router1 and Router2 the tunnel to Auto 6to4 mode, by removing the tunnel destination, changing the tunnel endpoint IPv6 address to a 6to4 address (2002:<ipv4 add:ress-hex>::/48) and changing the tunnel mode:

```
Router1(config)# interface Tunnel 1
Router1(config-if)# no ipv6 address 2001:B:100:1::1/64
Router1(config-if)# ipv6 address 2002:<ipv4-add:ress-hex>::<nnnn>/48
Router1(config-if)# no tunnel destination <ipv4-address>
Router1(config-if)# tunnel mode ipv6ip 6to4
Router1(config-if)# exit
Router1(config-if)# ipv6 route 2002::/16 Tunnel 1
```

Make a similar configuration in Router2. Define an IPv4 default route from Router2 to Router 1 and vice-versa.

```
Router1(config)# ip route 0.0.0.0 0.0.0.0 <ip-address-R2>
```

Restart a capture on Net B. From Router1 execute the following commands:

```
Router1# ping 2002:A00:1::1
Router1# ping 2002:88C0:1::1
Router1# ping 2002:101:101::1
```

Analyze the captured packets.

6to4 address example: 10.11.1.2 → 2002:0A0B:0102::...

20. Define the necessary IPv6 static routes in order to obtain full IPv6 connectivity using the Auto 6to4 tunnel.