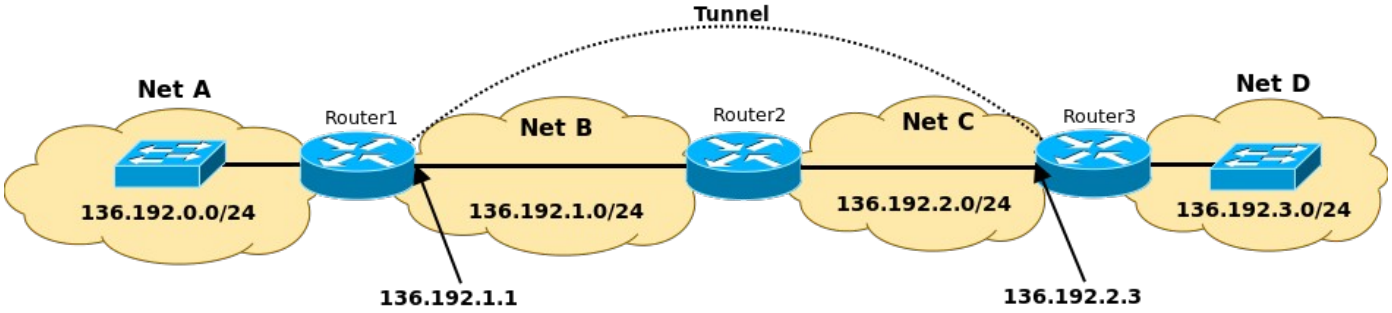
Arquitetura de Redes

Laboratory Guide

Objectives

- IPv4 Tunnels.
- IPv6 over IPv4 tunneling.
- 6to4 tunnels.

IPv4 Tunnels



1. Assemble the above depicted network, start by configuring all interfaces' IPv4 addresses and OSPF in all routers. Verify the interfaces' configurations and 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 136.192.2.3
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 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) requires an IP address.

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

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

6. Change the type of the Tunnel to GRE IPv4:

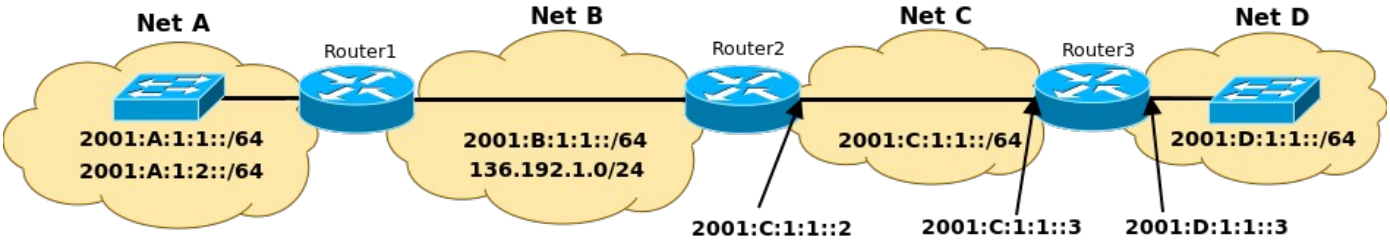
```
Router1(config)# interface Tunnel 0
Router1(config-if)# tunnel mode gre ip
```

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

Note: The GRE IP tunnel allows multicast traffic, therefore OSPF updates may now been sent also by the tunnel interfaces. To avoid routing loops (tunnel requires knowledge of destination, destination is learned by OSPF, destination is learned via tunnel), is advisable to make the tunnel interfaces passive:

```
Router1(config)# router ospf 1
Router1(config-router)# passive-interface Tunnel 0
```

IPv6 over IPv4 Tunneling



7. Assemble the above depicted network, start by configuring all interfaces' IPv6 and IPv4 addresses. 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
```

Configure all necessary static routes to achieve full IPv6 connectivity:

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

Re-verify the routing tables and test the connectivity between the devices.

Note: Do not forget to active IPv6 routing: `ipv6 unicast-routing`

8. **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
```

Repeat similar configuration in Router2. Re-verify the routing tables and retest the connectivity between the equipment.

9. Restart a capture on Net B. From Router2 ping Router1's Tunnel 1 IPv6 address. Analyze the captured packets.

10. 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.

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

12. 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.

6to4 Tunnels

12. 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
```

Repeat 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:

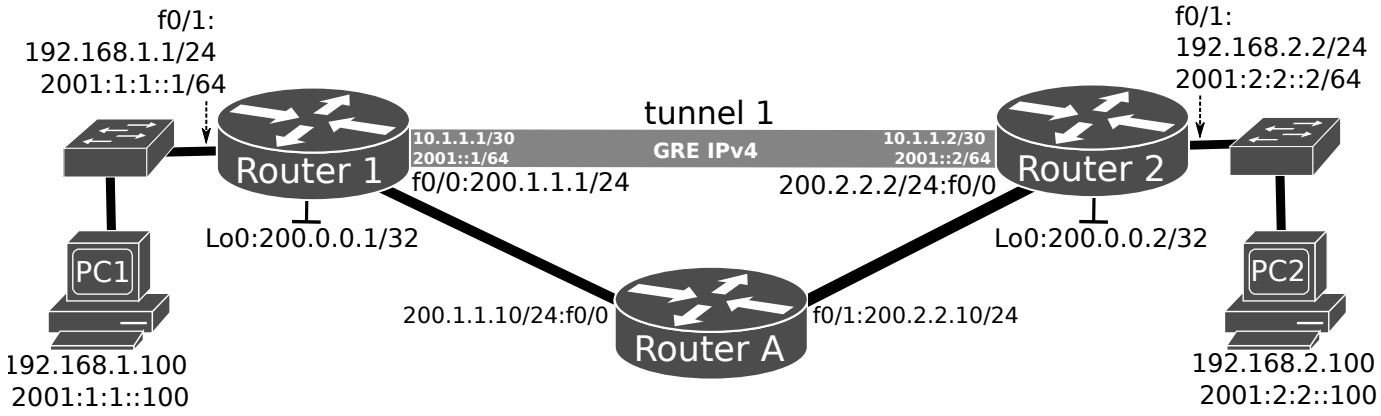
```
Router1# ping 2002:88C0:0102::2
Router1# ping 2002:A00:1::1
Router1# ping 2002:88C0:1::1
Router1# ping 2002:101:101::1
```

Analyze the captured packets.

6to4 address examples: 10.11.1.2 → 2002:0A0B:0102::…
: 136.192.1.2 → 2002:88C0:0102::...

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

Routing through tunnels using PBR



14. Set up the above depicted network. Configure the IPv4 and IPv6 addresses and activate OSPF (process 1) for the all IPv4 networks (including Loopback interfaces' addresses).
Verify the IPv4 routing tables (show ip route).
Configure an GRE IPv4 tunnel (with overlay networks 10.1.1.0/30 and 2001::/64). On Router 1:

```
#interface Tunnel1
#ip address 10.1.1.1 255.255.255.252
#ipv6 address 2001::1/64
#tunnel source Loopback0
#tunnel destination 200.0.0.2
#tunnel mode gre ip
```

Configure also the overlay network routing with IPv4 and IPv6 Route Maps to the remote private networks (PC networks):

```
#ipv6 access-list L101
#sequence 20 permit ipv6 2001:1:1::/64 2001:2:2::/64
#access-list 100 permit ip 192.168.1.0 0.0.0.255 192.168.2.0 0.0.0.255
!
#route-map routeT1 permit 10
#match ip address 100
#set ip next-hop 10.1.1.2
!
#route-map route6T1 permit 10
#match ipv6 address L101
#set ipv6 next-hop 2001::2
!
#interface f0/1
#ip policy route-map routeT1            ! IPv4 policy routing activation
#ipv6 policy route-map route6T1                  ! IPv6 policy routing activation
```

Perform the equivalent configuration on Router2.
Verify the IPv4 and IPv6 routing tables. From PC1 ping PC2 (using IPv4 and IPv6 addresses) while capturing packets on links R1-RA and RA-R2. Analyze the dual IP headers (of overlay and underlying networks, respectively.
Note: tunnel end points virtual interfaces (VTI) do not require the same ID number, however, good configuration guidelines strongly recommend it.