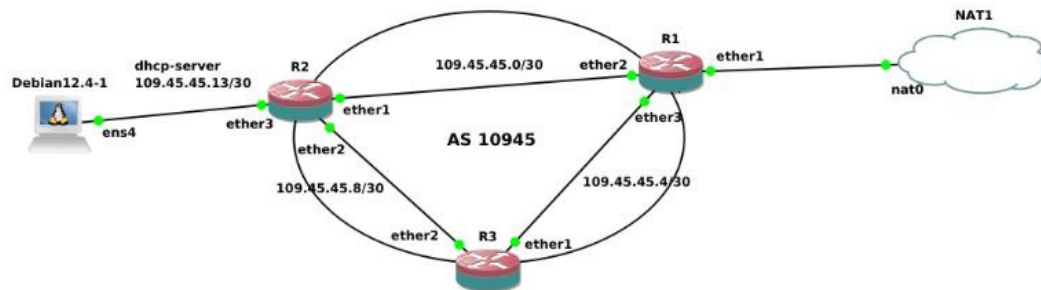


Task 5: Implementation of backbone networks with a mikrotik router and their interconnection with the BGP protocol.

Implement the following topology. The mikrotik router (version 7.11.2) will be used.

As username/passwd on ALL mikrotik routers, set admin/admin.



The backbone network consists of three routers for which static IP assignment will be done addresses and implementation of the ospf routing protocol.

- For the IP addresses of the trunk network we will use SI as below. Let the SI 1094545, you will assign the IP addresses 109.45.45.0/30. The use of subnetting with /30 minimizes the IPs that will be used on each subnet.

(Students whose SI has consecutive zeros in the 2nd or 3rd position MUST add +10 accordingly e.g. 1090044-> 1091044)

- For each router you will also assign a static IP address to the loopback interface and change its hostname.

An indicative implementation for R1 is given:

```
/system identity set name=R1
/interface bridge add name=loopback0
/ip address add address=10.255.255.1/32 interface=loopback0
/ip address add address=109.45.45.1/30 interface=ether2
/ip address add address=109.45.45.5/30 interface=ether3
```

The address values are indicative and should refer to the subnets to which the interfaces belong

ether2 and ether3 of R1. Repeat for R2 and R3.

➤ Check the routing paths with ip/route/print and the IP addresses with ip/address/print and

verify that each router has the correct addresses and can ping the

other people's facing interfaces and can NOT (yet) ping the non-facing interfaces

interfaces.

➤ Check that R1 can communicate with the external network.

Configuring ospf routing.

To implement an ospf network, two parameters are defined. The OSPF area identifier (area-id) and the

network name (name).

If the router is part of networks in more than one area, then there must always be an area with area-id=0.0.0.0 (backbone). The backbone always contains all border routers of an area. The backbone network is responsible for the distribution of routing information between areas that are not in the backbone. The backbone network must be continuous, i.e. there are no disconnected sections. However, area border routers do not need to be physically connected to the backbone - the connection to it can be simulated using a virtual connection.

The implementation is achieved by having each router announce/advertise its IP addresses loopback, the backbone area and adding the interfaces (hence subnets) that will belong to it. On Mikrotik routers these are achieved by creating an instance (instance) to be used by the ospf protocol.

An indicative ospf configuration for R1 is given:

Set instance with default name and adding the router-id of R1:	/routing/ospf/instance/ add name=default router-id=10.255.255.1 originate-default=if- installed redistribute=ospf,bgp,connected
Add to the instance the name of the network backbone: backbone and name area-id: 0.0.0.0	/routing/ospf/area/ add name=backbone area-id=0.0.0.0 instance=default
Adding interfaces and subnets that will form the backbone network	/routing/ospf/interface-template add network=109.45.45.0/30 area=backbone /routing/ospf/interface-template add network=109.45.45.4/30 area=backbone
Only for R1 will need the NATE activation	<see exercise 3>

Repeat for all routers R2 And R3.

Implement dhcp-server on R2 to assign an IP address to the debian terminal with a subnet, such as

as shown in the topology (109.45.45.13/30).

Allow a few seconds and revisit the routes of all routers with `/ip/route/print`.

Questions

- Ping all interfaces to make sure ospf is working.
 - Run `ip/route/print` on R1,R2,R3 and show the output. Is there a route to the outside network (0.0.0.0/0) from all routers?
 - Run `ping 8.8.8.8` from all routers and check if they have access to the external network. You will find that all routers are communicating with the external network and have a path in the routing table for 0.0.0.0/0.
 - Why does the `/tools/traceroute google.com` command only work from R1?
 - Run `/tool/traceroute 8.8.8.8` from R2 and check which path the packets.
 - Remove the connection between R1-R2, run `/tool/traceroute 8.8.8.8` from R2 and check from which route the packets are now being routed.
 - If everything is implemented correctly, you will see that packets are automatically routed from another
- => the ospf protocol works!
- In case of not using ospf all routes should be added as static e.g.
- ```
ip/route/add dst-address=0.0.0.0/0 gateway=109.45.45.1 distance=1
```
- Restore the R1-R2 connection and the routing will revert to the shortest path.
  - Run `traceroute` from debian and point the routes to R1 and 8.8.8.8.

### Implementation of network interconnection using the Border Gateway Protocol.

To interconnect two autonomous networks, we will duplicate the topology as shown in the following figure.

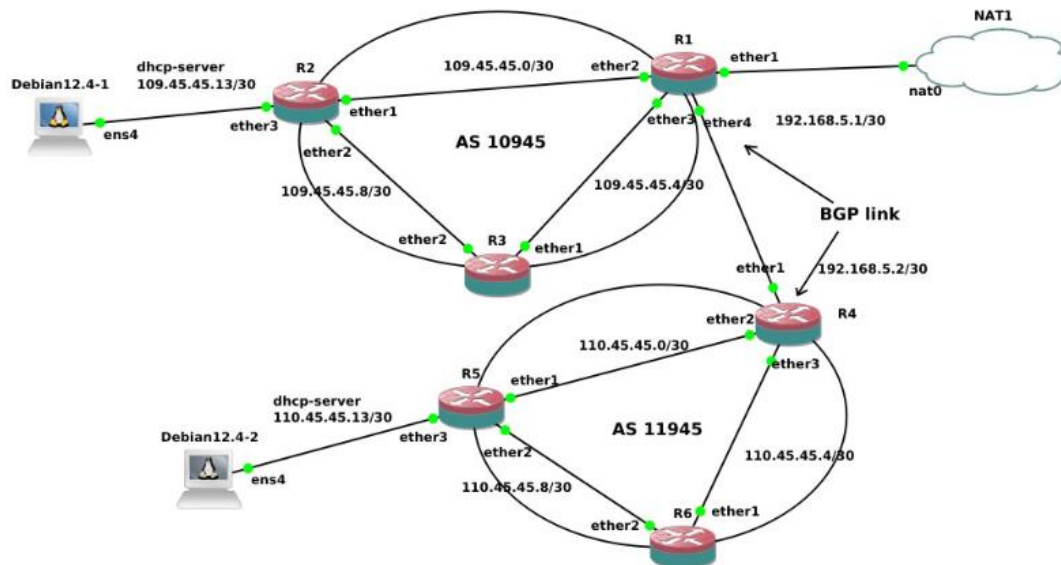
To implement the 2nd backbone network we will use different route-id (router-id=2.2.2.2 and

name=backbone2) but also subnet addresses, as in the following topology.

For example if your SI is 1094545 then for the backbone network use

`109+1.45.45.0/30 => 110.45.45.0//30`, as shown in the topology.

In R4. NO need to implement NAT (why?)



### Configure BGP connection R1

To implement the bgp connection, the Mikrotik router uses a template with parameters and activates the connection. First, addresses must be added.

|                                                                                                                                                                              |                                                                                                                                                                                                                                                           |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Assigning the ether4 address 192.168.5.1                                                                                                                                     | <see previous exercises>                                                                                                                                                                                                                                  |
| Create a bgp connection template.<br>As local AS number you will put the first 5 digits of your registry. 1094545=>10945                                                     | /routing/bgp/template/add name=bgp-template<br>router-id=10.255.255.1 as=10945<br>output.redistribute=static,ospf,bgp routing-table=main                                                                                                                  |
| Create a connection and connect.<br>As remote AS number of the 2nd network, you will enter the AS of the first network +100 =><br>10945+100=11045 (defined in R4, see below) | /routing/bgp/connection/ add name=toR4<br>remote.address=192.168.5.2<br>remote.as=11045<br>templates=bgp-template local.port=179<br>remote.port=179 listen=yes connect=yes<br>output.default-originate=if-installed<br>local.role=ebgp keepalive-time=60s |
| Check the settings and if the connection is active.                                                                                                                          | /routing/bgp/connection/print                                                                                                                                                                                                                             |

### Questions

- Ping all interfaces to make sure that ospf/bgp is working.
- Run ip/route/print on R1,R2,R3,R4,R5,R6 and show the output. There is a route to external network (0.0.0.0/0) from all routers?
- Why was NAT not needed on R4?
- Run traceroute from debian-12.4.2 and show the routes to 8.8.8.8.

- Run traceroute from debian-12.4.2 to debian-12.4.1 and show the routes