# Network Architectures (AR)

BSc in Telecommunications and Informatics Engineering (LETI)

# Final Project

## 1 Introduction

The objective of the final phase of the AR project is to implement, configure, and test a networking architecture to show your knowledge in terms of networking protocols and equipment configuration. This project is performed in groups of 2-3 elements (same group as in the intermediate project). The project network architecture is shown in Figure 1.

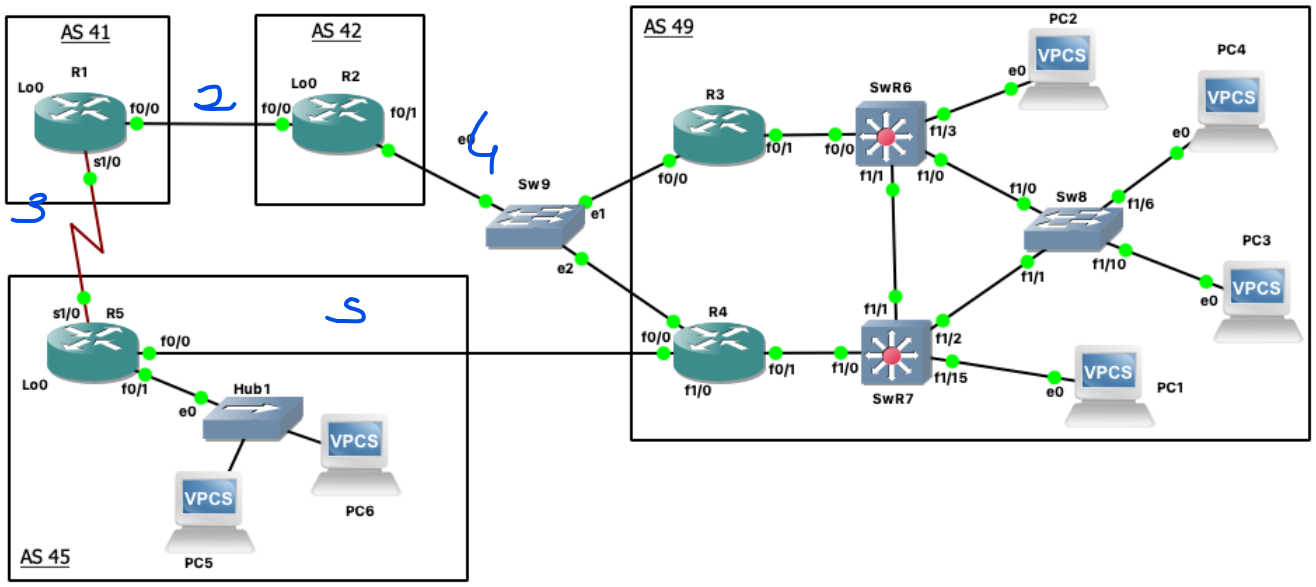


**Figure 1 – Project network architecture.**

The main task is to build the network and configure the devices shown in Figure 1. Hosts should be implemented with VPCS. The network elements include routers (R), switches (Sw) and switch-routers (SwR). The NM16-ESW should be used **only** on switches and switch-routers. Sw9 can be an unmanaged switch. Add appropriate serial modules to routers R1 and R5. R4 also needs a routing interface (NM-1FE-TX). The Sections 2-5 apply to IPv4 only.

## 2 Addressing

Consider that X is the number of your group in fenix. To start with, configure IPv4 addresses in all network elements, considering the following rules:

- Connections between ASes should be made from the block address 172.16.X.0/24 with a mask of /29.
- AS49 should use private addresses in the range of 10.49.Z.0/22 (for all networks) and public addresses in the range 194.49.X.0/25 with Z = 4*X.
- AS 41, AS42 and AS45 should use the block address 194.41.X.0/24, 194.42.X.0/24 and 194.45.X.0/24 for their loopback addresses. AS45 should also use 194.45.100.0/24.

## 3 AS49 configuration

Now, perform and test the following configurations:

- Four VLANs (one for default VLAN). On the switch (or switch routers) assign interfaces f1/3 – f1/5 to VLAN A, f1/6 – f1/9 to VLAN B and f1/10 – f1/12 to VLAN C. The remaining ports should be in the default VLAN or be trunk. A, B and C can have any permitted VLAN value.
- The Inter-VLAN routing should be performed in switch-router SwR6. Any Sw or SwR can have PCs on any VLAN.
- Sw8 should have an IP address for management purposes on VLAN 1.
- A DHCP server in R3 should provide automatic IP addressing to all VLAN hosts of AS49.
- A NAT box in SwR6 such that the private addresses of AS49 (used only in VLANs) are translated to a network with prefix 194.49.X.0 and /26 mask. You must use a NAT overload configuration to use a range of IP public addresses.
- Note that R4 must have its f0/1 interface configured in the trunk mode (without requiring an additional switch module) and that R3 must know all the IP private networks to be able to reply to DHCP requests.

## 4 Other ASes configurations

- AS45 should have PCs with statically configured hosts.
- IP addresses should be assigned in every interface as usual (including loopback 0).

## 5 Routing protocols

The connectivity between all network elements (PCs, routers, etc.) should be always assured.

- All public network addresses owned by each AS should be advertised by BGP. Naturally, private addresses should not be advertised and thus for AS49, only the public network should be exported.
- AS49 must use redistribution of the networks, they cannot be specified statically (via *network* command).
- Configure BGP in all autonomous systems: eBGP should be configured between routers of different ASes and iBGP between all eBGP routers inside each AS (for the case of more than one router per AS). Note that AS42 establishes two eBGP connections to AS49 and every AS must have at least two eBGP connections.
- AS45 should be a non-transit (AS) and should prefer to use for all outbound traffic the connection between R5 and R1. The same applies to inbound traffic. Note that remaining ASes are transit ASes.
- AS49 must use for inbound and outbound traffic both interfaces (according to the BGP rules). All traffic between R3 and R4 cannot cross switch Sw9.

## 6 DNS and IPv6 connectivity

- Configure a DNS server in R1 of AS41 such that hosts *rafa* and *angel* (in AS 45) are accessible by names rafa.ar.org, angel.ar.org.
- Configure IPv6 addressing, OSPFv3 and multiprotocol BGP routing such that the hosts/routers of AS42, AS42 and AS45 can communicate using IPv6 addresses. The IPv6 addresses of *rafa* and *angel* should be configured through the auto-configuration process. The global addresses must be in the range 2001:db8:Y:XZ::/64, where Y is the AS number and Z is some chosen network ID number.

## 7 Additional configurations

After having the previous configurations done, the following shoul be performed:

- Use unnumbered serial interfaces between AS41 and AS45.
- Use Hot Standby Router Protocol (HSRP) to have a redundant default gateway for the hosts on private addressing space (VLANs). The idea is to add another router that in case SwR6 fails it still provides full connectivity to all the VLAN hosts. If correctly implemented, this functionality may add 2.0 values of bonus to the final lab evaluation grade.

## 8 Evaluation

You must write a report of the work and upload one zip file with the GNS3 configuration and with a short report describing what was done. The evaluation will be based on the report and eventually on a short oral discussion, where you must demonstrate the operation according to the specifications. Make sure that all elements of the group are fully aware of the configuration details; elements that do not, will be penalized.

**The deadline for the submission is 12/01/2024, at 23:59.**

## 9 Code of conduct

Each student is expected to subscribe to the highest standards of academic honesty. This means that each idea that does not belong to the student must be explicitly accredited to the respective author. Failure to comply with this simple rule constitutes plagiarism. Plagiarism includes the use of ideas, code or solutions from other students or individuals, or any other sources in addition to the course supporting texts. The students can and should identify the source as comment (use ! in the beginning of a line) in the configuration code.

But students cannot copy configurations (or code) from other students or give their own configuration to others under any circumstances. Any plagiarism will have the immediate consequence of failing all students involved (including those that made it possible).