Network Architectures (AR)

BSc in Telecommunications and Informatics Engineering (LETI)

Project

1 Introduction

The objective 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. The project network architecture is shown in Figure 1.

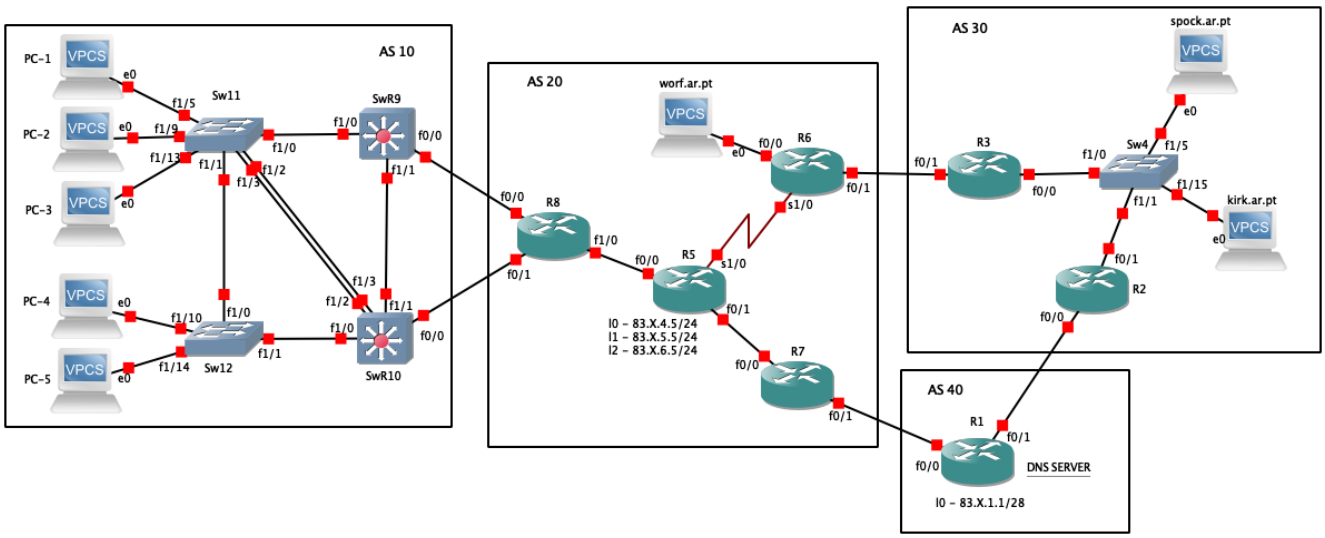

Figure 1 – Project network architecture.

The main task is to build and configure the network of Figure 1. Hosts can be implemented with VPCS (recommended) or Cisco IOS. The switching elements include routers (R), switches (Sw) and switch-routers (SwR). The NM16-ESW module should be used **only** on switches and switch-routers; all switches are managed (use routers and change image). Add an NM-4T serial module to routers R5 and R6. R8 requires an additional routing port and thus the 1FE-TX module needs to be added.

2 Addressing

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

- Connections between ASes should be made from the block address 7.7.X.0/24 with a mask of /29.
- AS 10 should use private addresses in the range of 10.X.80.0/22 (for all private VLANs) and public addresses in the range 193.10.X.0/27.
- AS 20 and AS30 should use the block address 193.20.X.0/25 and 193.30.X.0/25. For AS 20 and AS 40, use loopback addresses from the network address shown in Figure 1.

Considering the addresses given, calculate the IP network addresses needed for each LAN/VLAN of every AS. After, the configuration process can start. The phases 1-5 apply to IPv4 only.

3 Phase 1: AS 10 configuration

Now, perform and test the following configurations:

- Configure 4 VLANs (one for default VLAN) on the switches and switch-routers. Switches (or switch routers) should have interfaces f1/5 – f1/8 in VLAN A, f1/9 – f1/12 in VLAN B and f1/13 – f1/15 in VLAN C. A,B,C values are X+1, X+2, X+3, respectively. The remaining ports should be in the default VLAN (i.e. VLAN 1) or in the trunk mode.
- Configure Inter-VLAN routing in SwR9 and SwR10. Sw11/Sw12 can have hosts (PCs) on any VLAN. Although not shown in the network architecture, SwR9/SwR10 can also have hosts connected to f1/5 – f1/15 in any VLAN.
- Configure the connection between SwR9 and SwR10 to be used only by packets of VLAN 1 and VLAN A.
- Configure a DHCP server in SwR10 to provide automatic IP addressing to all hosts on VLAN A,B and C. Note that only private IP addresses should be assigned. The default gateway of hosts in VLAN A and VLAN B should be SwR9 and the default gateway of hosts in VLAN C should be SwR10.
- Configure a NAT box in SwR9/SwR10 such that the private addresses of AS 10 (used only in VLANs) are translated to a network with prefix 193.10.X.0/28 (for SwR9) and 193.10.X.16/29 (for SwR10). You must use a NAT overload configuration.
- Configure all switches and switch routers with an IP public address for management purposes on VLAN 1. VLAN 1 can only be used to carry non-private IPs (management) traffic. Note that there is still some public IP addressing space available in AS 10 (see section above). Routing between VLAN 1 and other VLANs can only be performed at SwR10.
- Configure an EtherChannel (port aggregation) in the connection between SwR10 and Sw11.

4 Phase 2: AS 20 configuration

Now, perform and test the following configurations:

- Configure the serial interface to not waste any IP address (unnumbered).
- Configure the loopback interfaces of R5 and the host worf.ar.pt with a manually configured IP address.
- Configure the OSPFv2 protocol to have routing between all network elements. Note that it should also be possible to ping loopback interfaces from any router or host.

5 Phase 3: AS 30 configuration

Now, perform and test the following configurations:

- Configure two VLANs A and B (with X and X+1) in Sw4. VLAN A should be the native VLAN. The spock.ar.pt PC should be in VLAN A and the kirk.ar.pt PC in VLAN B. Note that only switching interfaces can be used in Sw4.
- Configure the R2-f0/1 and R3-f0/0 interfaces to trunk 802.1Q VLAN traffic, i.e., use sub-interfaces to configure an interface for the two VLANs at R2 and R3.
- Configure R3 as the default gateway of spock.ar.pt and R2 as the default gateway of kirk.ar.pt. All PCs should have manually configured IP addresses assigned.

6 Phase 4: AS 40 configuration

Now, perform and test the following configurations:

- Configure the loopback interface 87.X.1.1/28.
- Configure a DNS server in R1 on the same network as the loopback interface. The DNS server should assure that spock.ar.pt, kirk.ar.pt (in AS 30) and worf.ar.pt (in AS20) are accessible by name anywhere.
- Configure all routers and switch routers to perform DNS name resolution. The hosts in AS10 should also be able to perform name resolution.
- Configure a HTTP server on R1. Test this server using telnet.

7 Phase 5: Inter-AS configuration

Since AS 10 is only connected to AS 20, there was an agreement between these two ASes to use RIP instead of BGP (why?). BGP should be used in all other ASes as the external routing protocol. Now, perform and test the following configurations:

- Configure RIP between SwR9, SwR10 and R8 to have connectivity between the two ASes. For AS 10, private addresses should not be advertised, and only public networks should be exported with RIP to AS 20. You may need to use a loopback interface or static routes (to null) for this to work!
- Configure BGP in all remaining 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). All public network addresses owned by each AS should be advertised by BGP.
- Redistribute routes from other protocols into BGP (and vice-versa) as much as possible and avoid any statically configured network.
- AS 30 is a non-transit AS and prefers to use for all outbound traffic the connection between R2 and R1. The connection of R3 to R6 should be used only as backup (no inbound traffic also). AS 20 and AS 40 are transit ASes.

8 Phase 6: IPv6 connectivity

Now, perform and test the following configurations:

- Configure IPv6 addressing, OSPFv3 and multiprotocol BGP routing such that the hosts/routers of AS 20, AS 30 and AS 40 can communicate using IPv6 addresses.
- The global IPv6 addresses must be in the range 2001:db8:X:YZ:/64, where Y is the AS number and Z is some chosen network ID number.
- IPv6 addresses of worf.ar.pt, kirk.ar.pt, spock.ar.pt should be obtained through the auto-configuration process.

9 Phase 7: Point-to-Point GRE VPN Tunnel (Bonus!)

Add a new routing interface in R3 and connect a host to it. Configure a Point-to-Point GRE VPN Tunnel between R3 of AS 30 and SwR9 (VLAN A). The idea is that the host is virtually connected to VLAN A of AS 10 even if it is not connected to it. This means that the host should use an IP private address of AS10, using a tunnel to forward packets to VLAN A. Communication between the host in AS 30 and PCs in AS10 should always go through the tunnel.

10 Evaluation

You must upload one zip file with the GNS3 configuration and a short report (max. 3 pages) and all configurations in annex. **The deadline for the submission is 12/12/2019, at 23:59. Note that all students will be evaluated during the 2nd test (and 1st exam) about the project.**

11 Code of conduct

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