Computer Networks I: Work Proposal

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November 2022
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Introduction

It is intended that students can implement the topology presented in Figure 1. The topology displays a network simulation of a medical clinic with a network access device layer (*Access Layer*) and a second aggregator layer of all access *switches* (*Distribution Layer*). The PCs must *be docker* containers (*netutils*), *the switches* A1, A2, A3, C1, C2 and C3 must be of type IOSvL2, router R1 should have the IOSvL3 image. The Server *device* is a virtual machine with Linux operating system (it is suggested to use the LINUX distribution bunsenlabs[1] (64-bit) or a *docker container* to play the role of server. The network configurations of the equipment are presented in table 1.

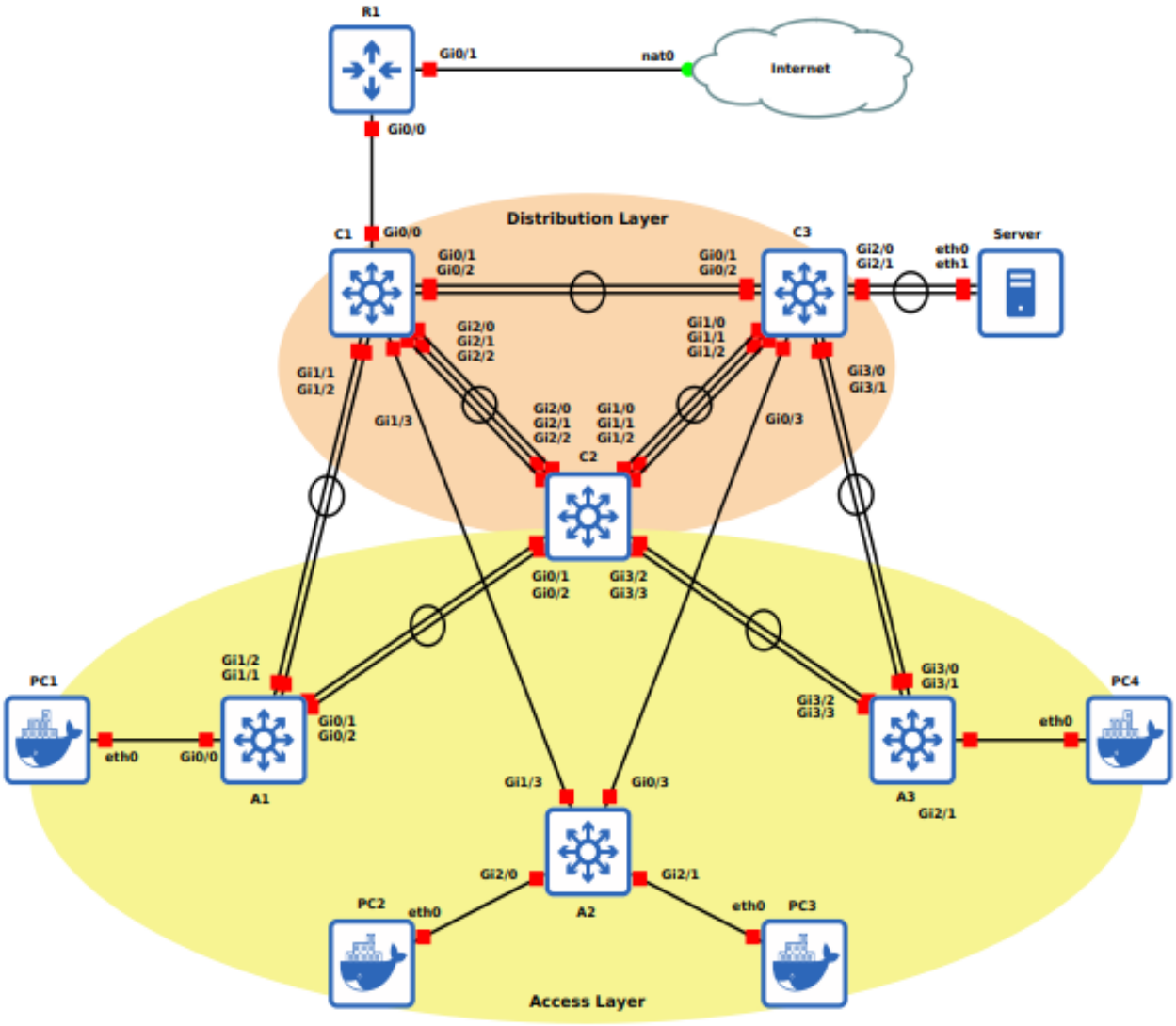

Figure 1: Network Topology

[1] https://www.bunsenlabs.org

Equipment	Interface	VLAN	IP	Gateway
A1	VLAN99	99	10.200.99.1/24	none
A2	VLAN99	99	10.200.99.2/24	none
A3	VLAN99	99	10.200.99.3/24	none
C1	VLAN99	99	10.200.99.11/24	none
C2	VLAN99	99	10.200.99.12/24	none
C3	VLAN99	99	10.200.99.13/24	none
PC1	Eth0	20	10.200. 20.1/24	10.200. 20.254
PC2	Eth0	10	10.200. 10.1/24	10.200. 10,254
PC3	Eth0	20	10.200. 20.2/24	10.200. 20.254
PC4	Eth0	30	10.200. 30.2/24	10.200. 30.254
Linux Server	bond0.10	10	10.200.10.253/24	10.200.10.254
	bond0.20	20	10.200.20.253/24	10.200.20.254
Router	gi0/0.10	10	10.200.10.254/24	Gi0/1
	gi0/0.20	20	10.200.20.254/24	Gi0/1
	gi0/0.30	30	10.200.30.254/24	Gi0/1
	gi0/1	-	DHCP	DHCP

Table 1: Data for equipment configuration

Project objectives

1. **Configure, test, monitor, and troubleshoot aggregated links based on *the Link Aggregation Control Protocol*** (LACP)

    - Create *EtherChannel* interfaces
    - Associate physical interfaces with *EtherChannel* and analyze the different LACP association modes (*on*, *passive* or *active*)
    - Describe the purpose of setting the LACP priority on a switch port.
    - Describe and test the different load balancing modes on *EtherChannel*.
    - Describe the meaning of the output of the "*show etherchannel summary"* and "*show etherchannel port"* commands.
    - Explain what happens when *EtherChannel elements* become unavailable. Demonstrate with practical cases.
    - Configure the LACP protocol on the Linux Server[2] by installing and activating and configuring the necessary modules. Test LACP operation between CISCO IOS and LINUX.
    - Use *wireshark to* capture the frames referring to the LACP protocol (IEEE 802.3ad)

[2] https://wiki.debian.org/Bonding

and analyze its contents.

- Explore and implement the possibility of replacing C2 with a Switch from another manufacturer (e.g. Arista) (LACP Multivendor)

2. **Configure, test, monitor, and troubleshoot network interfaces in the presence of VLANs**

    - Describe the IEEE 802.1q protocol.
    - Configure interfaces in *access* and *trunk* mode as required in Figure 1.
    - Describe and test the different configuration modes of *Dynamic Trunking Protocol* (DTP) (*Switch (config-if)# switchport trunk ?*).
    - Configure VLAN interfaces (L3) on switches, Linux Server and Router ("*ROAS-Router On A Stick*").
    - Study and implement the possibility of eliminating the Router from the topology assuming C2 this role using SVIs (Virtual Switch Interfaces) and physical ports L3 ("*routed ports*")
    - Analyze the state of interfaces related to VLANs (*Switch#show interfaces <intf> switchport; Switch#show trunk interfaces*)
    - Using wireshark *to capture* the *frames* for the IEEE 802.3q protocol and analyze its contents.

3. **Configure, test, monitor and repair the *Vlan Trunking Protocol* (VTP)**

    - Describe domains, modes, and different VTP protocol announcements
    - Create the required VLANs according to the following table.

VLAN ID	Name	Network Prefix	Gateway
99	Management	10.200.99.0/24	none
10	Diagnosis	10.200.10.0/24	10.200.10.254
20	Office	10.200.20.0/24	10.200.20.254
30	Guest	10.200.30.0/24	10.200.30.254

    - Configure C2 as VTP server and the remaining *switches* as VTP clients.
    - Analyze the state of the VTP protocol (*Switch#show vtp status*)
    - Discuss the importance of VTP *pruning*.
    - Using *wireshark to* capture the *frames referring* to the VTP protocol and analyze its contents.

4. **Set up, test, monitor, and troubleshoot *the Spanning Tree* protocol (802.1D and PVST+) in a local network topology**

    - Describe the operation of the STP protocol (IEEE 802.1D) and understand the main differences for the protocols RSTP (IEEE 802.1w), PVST+ and *Rapid* PVST+.

- Configure switch priorities according to the following table:

Switch	VLAN10	VLAN20	VLAN30
C1	4096	8192	4096
C2	8192	4096	8192
C3	8192	24576	4096

- Analyze the state of the STP protocol (*Switch#show spanning-tree vlan* <*id*>) for each of the VLANs in the topology.
- Explain the reconfiguration of the network in case of topological change.
- Explain the concepts of *PortFast*, *UplinkFast* and *BackboneFast* and apply them in the topology.
- Use *wireshark to* capture BPDUs for the STP protocol when it converges and analyze its contents.

5. **Run and explain connectivity and access tests between equipments**
    - View and explain mac address tables for *switches*
    - Describe and configure security on switch interfaces (*switch(config-if)# switchport-security ?*).
    - Describe and configure security to access the switches and routers.
    - Configure Internet access using the GNS3 NAT device (the operation of this protocol is outside the scope of this work and will be seen next semester).
    - Run connectivity tests using *ping* and *traceroute and* be able to explain their result.

Presentation, files, and documents to be delivered

The project will be carried out individually or by a group of up to three students. The presentation will take place in person on a date to be designated by the teacher. Until the indicated deadline, each group must submit in Canvas the configurations of the equipment (using the GNS3 function for exporting portable projects) and a brief report indicating the configurations performed for each of the five objectives as well as screenshots showing the tests carried out, state of operation of the equipment and associated packet captures **always framed by explanatory text** .

Evaluation Criteria

- ***Sufficient***

  Basic settings made and explained. Tests of connectivity between equipment working properly and properly grounded. Demonstrate basic knowledge of LACP operation, VLANs, VTP, and STP. Be able to explain 50% of the points required in each of the objectives.

- ***Good***

  In addition to the previous objectives, be able to correctly explain the consequences for the implemented protocols on topological changes (such as the shutdown of a network interface, a *switch*, etc.). Be able to explain 75% of the points indicated in each of the objectives.

- ***Very Good***

  In addition to the previous objectives, be able to explain in detail the LACP configuration of the Linux server and Internet access using the Router. Be able to explain the content of protocol

messages captured in real *time by wireshark* and associate those messages with events that occur in the network topology. Be able to explain 90% of the points indicated in each of the objectives.

Additional Bibliography

CCNA 200-301 Official Cert Guide, Volume 1, Wendell Odom, 2020 CISCO Press