Lab No. 04 - Application Layer and Physical Layer Protocols

Objectives

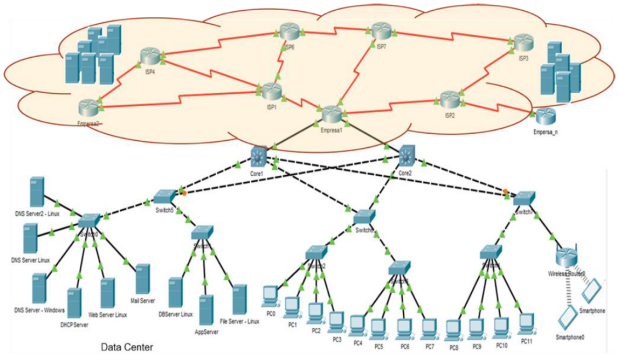
- Monitor the application layer protocols.
- Review the structured cabling standard and its application.
- Perform cable punching with RJ-45 connectors and patch panels.

Tools to Use

- Items provided by the university
  - Computers
  - Internet access
  - Patch panel and face plate
  - Punch tools (for patch cords and impact punches)
  - Cable strippers and wire cutters
  - Cable tester
- Items to be brought by the students
  - 4 to 6 meters of UTP/FTP CAT5 or CAT6 cable
  - 8 RJ-45 connectors
  - If available:
    - Cable stripper or utility knife, and wire cutters
    - Punch tool for patch cords
    - Cable tester

Introduction

We are working on the infrastructure of a company, which typically includes several IT infrastructure services. It consists of both wired and wireless user stations and servers (physical and virtualized), all connected through switches (layer 2 and 3), wireless equipment, and routers that link the network to the internet. It is also common to have cloud infrastructures where resources are provisioned based on the organization's needs. Within the servers, you can find web services, DNS, email, databases, storage, and applications, among others. Let's remember the configuration we are using as the base:



In this lab, we will focus on application layer protocol testing and perform activities related to the physical layer.

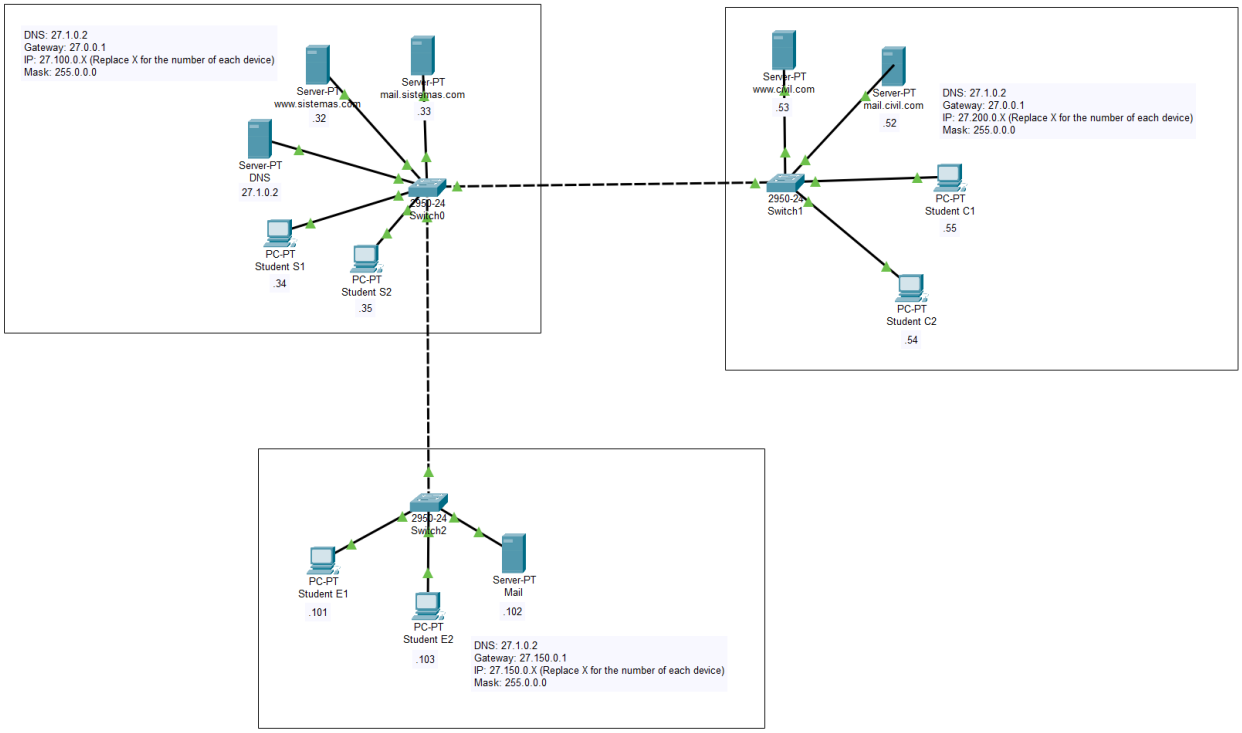
Experiments

Understanding how messages circulate across the network and being able to analyze their contents is important for reviewing and fine-tuning the network. In this part of the lab, we will review the information on the application layer and transport layer protocols (only the ports) that we have covered.

1. Cisco Packet Tracer

[For groups of 1, 2, and 3 students]

Using Packet Tracer, each student should configure the network presented below and document the experience. The services for DNS, HTTP, FTP, and email must be configured on the servers for the network presented.



2. Network Configuration

[For groups of 1, 2, and 3 students]

- Include the servers and clients presented, connect the cables, and assign DNS, Gateway, IP Address, and Subnet Mask to each device following the configuration shown in the diagram.
- Send messages between the devices in the network and verify connectivity between all of them.

3. Service Configuration

[For groups of 1, 2, and 3 students]

a. DNS

- In the DNS service with IP 27.1.0.2, include the following entries:
  - sistemas.com with the IP of the mail server for sistemas.com
  - pop3.sistemas.com as an alias for sistemas.com

  - smtp.sistemas.com as an alias for sistemas.com
  - http.sistemas.com with the IP of the web server for sistemas.com
  - www.sistemas.com as an alias for http.sistemas.com
  - civil.com with the IP of the mail server for civil.com
  - pop3.civil.com as an alias for civil.com
  - smtp.civil.com as an alias for civil.com
  - http.civil.com with the IP of the web server for civil.com
  - www.civil.com as an alias for http.civil.com

- In the DNS server with IP 27.1.0.2, include the following entries:
  - electrica.com with the IP of the mail server for electrica.com
  - pop3.crear.com as an alias for electrica.com
  - smtp.crear.com as an alias for electrica.com

- Start the service, and from a client machine in each company, use the ping command by name in the command line to verify that the service is working properly.

b. HTTP

- On the web servers, configure the HTTP service. Modify the web pages of the servers to recognize which faculty they belong to (personalize it for each faculty). Start the service.
- From the client stations, try connecting to the web servers:
  - Make the request for the web page using the IP addresses of each server.
  - Make the request for the web page using the URL of each server.
  - Using simulation mode, check the contents of the PDU at the application layer.

c. Email

- On the mail server of each faculty, include email accounts for the users of each faculty. Use the client computer names as user names. Start the service.
- From the client stations, test the service:
  - Configure the email clients for each domain.
  - Send emails between stations in the same domain.
  - Verify receipt of the emails on the stations and reply to the received messages.
  - Send emails to clients in other domains.
  - Verify receipt of the emails on the stations and reply to the received messages.
  - Using the simulation tool, check the contents of the PDU at the transport and application layers during the email sending process between the sending client and its SMTP server and between the receiving client and its POP3 server.

d. FTP

- On the sistemas web server, configure the FTP service. Create a user with your first name and password as your last name (e.g., in my case, it would be username: claudia and password: santiago). Start the service.
- From the client stations, try connecting to the FTP server and download a file:
  - From the command line, access the FTP server (by name or IP address) using the telnet command.
  - Log in with the created username/password.
  - Download one of the files from the server.
  - Exit the server and verify that the file is on the client.

  - Present the command log of the commands used.
- From simulation mode, re-enter the FTP server and upload the .TXT file from the client. Check the headers at the application layer that indicate the connection, username and password submission, acceptance confirmation messages, file upload, and end of communication.

In the Real Network

1. Wireshark

[For groups of 1, 2, and 3 students]

Using the Wireshark tool, perform and document the following tests:

a. Make a web query to the Computer Lab website and see which application layer protocols are active. Analyze the application layer information and transport layer ports in the content of the captured packets.

b. Capture the DHCP traffic from your computer and analyze the packets that circulate between the client and the servers offering addresses. Check the content of the packets at the application layer and transport layer ports.
Note: To perform this activity, capture the traffic, remove the IP address from the machine (type ipconfig /release in the command line) and request it again (type ipconfig /renew in the command line).

c. Analyze the application layer information and ports (transport layer) in the content of the captured packets in an HTTP connection:

- Unlock the use of the TELNET protocol on your computer.
- Capture the packets when using TELNET and HTTP protocols and show the application layer messages generated in the following queries:
- Capture the following web page http://profesores.is.escuelaing.edu.co/ csantiago/RECO/index.html using the protocols:
  - Telnet
    - telnet profesores.is.escuelaing.edu.co 80
    - GET path/file (e.g., GET /index.html).
    - Download the PDF file prueba.pdf
    - Download the image file network.png
  - HTTP
    - Use the browser to view the same pages you accessed with TELNET.
    - Present and explain the capture results.
    - What difference do you find between the files downloaded via TELNET and via the browser?

2. DNS Service Test

[For groups of 1, 2, and 3 students]

Perform the following DNS tests. Go to https://centralops.net/co and check the domains listed below and perform the indicated tests:

- escuelaing.edu.co
- jbb.gov.co
- google.com
- Test one more domain from a non-American organization.

For each one, indicate:

- How many domain servers does it have?

- How long ago was this domain assigned?
- Who is it registered with?
- What is the registration entity's ID?
- When was the record last updated?
- How long is the record valid for?
- What is the assigned IP range and by which registration authority was it given?
- Which company was it assigned to?

For each one, present the results with a screenshot and explanatory text.

3. NTP Server

[For groups of 1, 2, and 3 students]

Why is it important to ensure all computing devices in an infrastructure have the same time? Install an NTP server on one of your machines and configure the other machines (Linux Slackware, Solaris, Windows Server, and CentOS for groups of 3) to sync their time with the NTP server. A total of 1 NTP server should be configured on Solaris or Linux Slackware, and the other operating systems installed in Lab No. 1 and 2 on virtual machines, with all the physical machines configured as NTP clients.

For example, in the case of 2-student groups, the installation could be:

- Team No.01:
  - Solaris → NTP Server
  - Linux Slackware → NTP Client
  - Windows Server with GUI → NTP Client
  - Windows Server without GUI → NTP Client
  - Android → NTP Client
- Team No.02:
  - Linux Slackware → NTP Server
  - Solaris → NTP Client
  - Windows Server with GUI → NTP Client

4. Structured Cabling and Cable Construction

[For groups of 1, 2, and 3 students]

To build a technological infrastructure, elements are required to connect computing devices. The structured cabling standards are used to connect elements, maintain order, facilitate growth, and promote the management of network physical elements. The following activities are focused on understanding this structure.

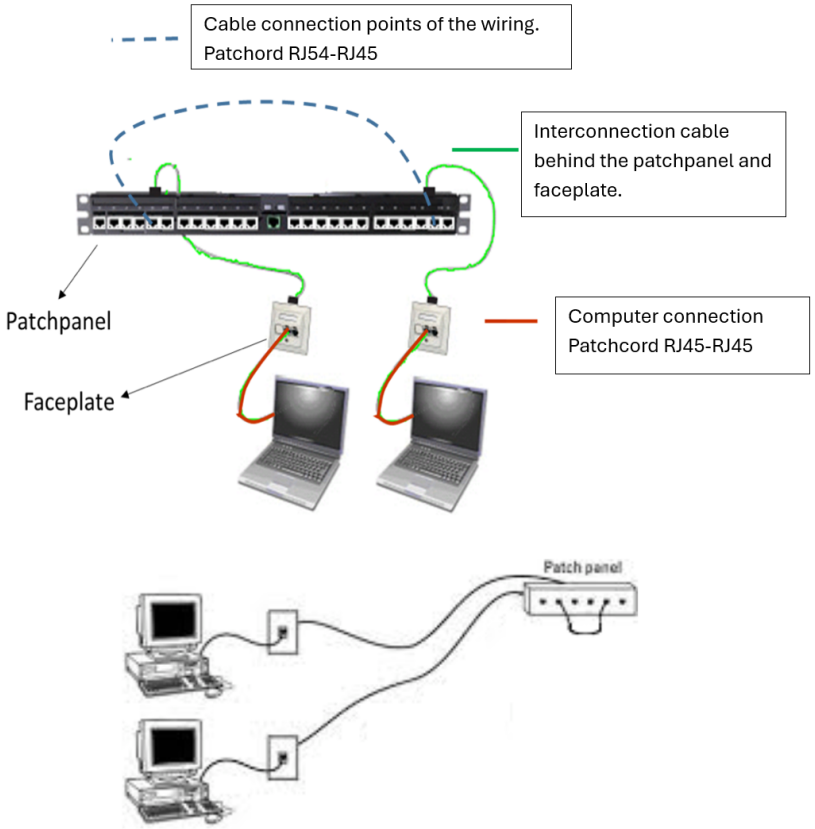
a. Patch Cord Construction

Individually:

- Following the professor's instructions and the presentation posted in the classroom, crimp two RJ45-RJ45 cables, one straight and one crossover.
- What is the purpose of each one?
- Use the cable tester to check that the cable was correctly made.
- Document the process and include photos proving you made it.
- Show your professor the result of your work.

b. Patch Panel Crimping

In your usual workgroups:



- Perform a horizontal cabling crimping test to connect two computers using a patch panel and two faceplates (each with at least one information outlet).
- Use the following diagram to perform the crimping:
- To test the operation, you can do it in two ways:
  - Connect the lab computers and ping between them.
  - Use the cable tester to check the continuity in the connection and crimping.
- Document the process. Include photos proving that you did it.
- Show your professor the setup.

c. Knowledge of the University's Structured Cabling

Observe the structured cabling in Building I at the School and identify the components of the structured cabling in the building. Include photos related to the topic (which prove that you took them).