Instituto Superior de Engenharia de Lisboa

Computer Networks

Phase 3 - Connecting Multiple Networks

Projeto ISEL 2023/24 — LEETC

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Listings

Acronyms list

API	Application Programming Interface
CLI	Command Line Interface
CMD	Command Prompt
GUI	Graphical User Interface
HTTP	Hyper Text Transfer Protocol
HTTPS	Hyper Text Transfer Protocol Secure
IP	Internet Protocol
IPv4	Internet Protocol version 4
IPv6	Internet Protocol version 6
LAN	Local Area Network
OS	Operating System
OSS	openSUSE
PC	Personal Computer
PHP	PHP: Hypertext Preprocessor
SSL	Secure Sockets Layer
TCP	Transmission Control Protocol
TLS	Transport Layer Security
TUI	Terminal User Interface
UDP	User Datagram Protocol
VPN	Virtual Private Network
WWW	World Wide Web
XAMPP	Cross-Platform, Apache, MySQL, PHP, and Perl

Glossary

Apache2
An opensource HTTP web server.

Bit
A unit of information in computing and digital communications. The bit represents a logical state with one of two possible values, 0 or 1 (other representations such as *true / false* are also valid).

Byte
Also a unit of digital information, consists of 8 bits.

Broadcast
A method of transferring a message to all recipients simultaneously.

Browser
A browser is a internet navigation software. It comes in multiple flavours, nowadays the big three are Microsoft Edge, Mozilla Firefox and Google Chrome.

Cisco Packet Tracer
A cross-platform visual network simulation tool.

Command Prompt
The default command-line interpreter for Windows operating systems.

Firewall
A barrier between networks. Controls inbound and outbound traffic.

Gateway
A network gateway provides a connection between networks and devices. Known as protocol translation gateways or mapping gateways, can perform protocol conversions to connect networks with different network protocol technologies.

LibreWolf
An internet browser based on Mozilla's Firefox. It's primary purpose is to allow privacy, and with it comes security. It achieves this by removing telemetry and data collection.

Linux
Open-source Unix-like operating systems based on the Linux kernel.

MariaDB
A community-developed fork of MySQL database server.

openSUSE Tumbleweed
An openSUSE (OSS) is an open-source community driven Linux-based distribuition sponsored by SUSE Software Solutions. Tumbleweed is a rolling release version allowing for up-to-date software releases.

Operating system
A program that manages a computer's resources from software to hardware.

Ping
A software utility used to test the reachability of a host on an IP network.

Tracert
Or **traceroute** in unix and linux systems, is a computer network diagnostic command for displaying possible routes and measuring transit delays of packets across an IP network.

Ipconfig
Or **ifconfig** in unix and linux systems, is a console application program that displays all current TCP/IP network configuration values.

Python
Python is a high-level programming language, object-oriented.

Perl
A high-level, general-purpose, interpreted, dynamic programming language

Rolling release distribuition
A distribuition where it's software release cycle is more frequent than those of Long Term Support (LTS). It's up to the Linux-based distribuitor to guarantee the testing of a package.

Router
A networking device that forwards data packets between computer networks, including internetworks such as the global Internet.

Switch
A networking hardware that connects devices on a computer network by using packet switching to receive and forward data to the destination device.

Socket
A network socket serves as an endpoint for sending and receiving data across the network.

Subnet Mask
Is a logical subdivision of an IP network.

Unix
Is a family of multitasking, multi-user computer operating systems that derive from the original AT&T Unix.

VPN
A private network creating a secure connection between a device and a network.

Windows
Microsoft's operating system. First released in 1985 as a Graphical User Interface (GUI) for MS-DOS, continued to evolve with it's latest version being 11. Due to it's nature, it's not recommended for server production environment.

Wireshark
Wireshark is a network protocol analyser software. Allows traffic capture between a computer and a network.

XAMPP
A software package environment collection containing Apache2 webserver, MariaDB database, PHP and Perl.

Chapter 1

Introduction

For phase 3

Chapter 2

Phase 3

This first part is very simple. There are two devices (PC0 and Laptop0) connected to a switch and their network starts with 192.168.***GROUP NUMBER***.0.
After applying the configuration we must run a set of commands to test our network.

- Ping: to test connectivity between devices over IP.
- Tracert: diagnostic command for displaying possible routes, also measures transit delay of packages across IP.
- Ipconfig: console application program of some computer operating systems that displays all current TCP/IP network configuration values. Unix and linux equivalent is *ifconfig*.

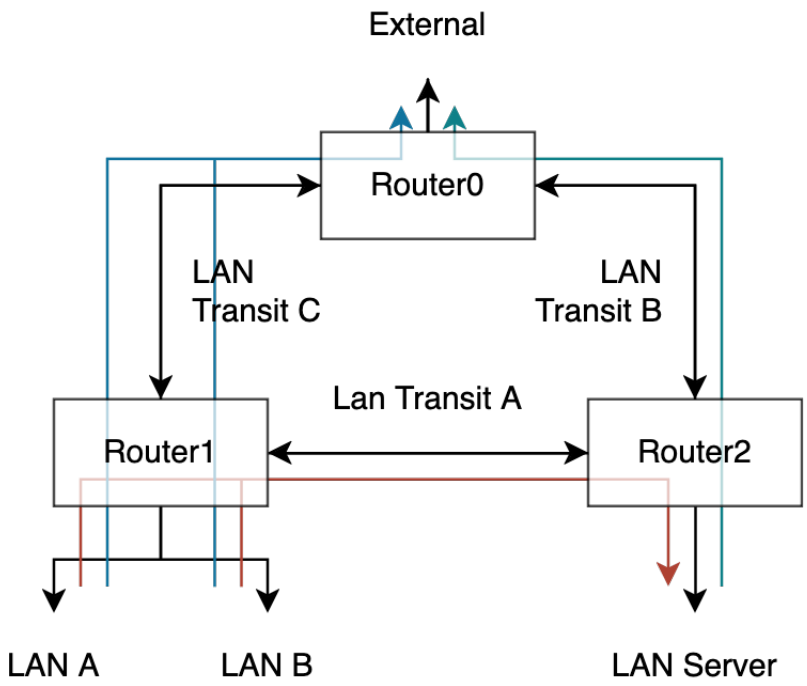

Figure 2.1: Part 2 network diagram

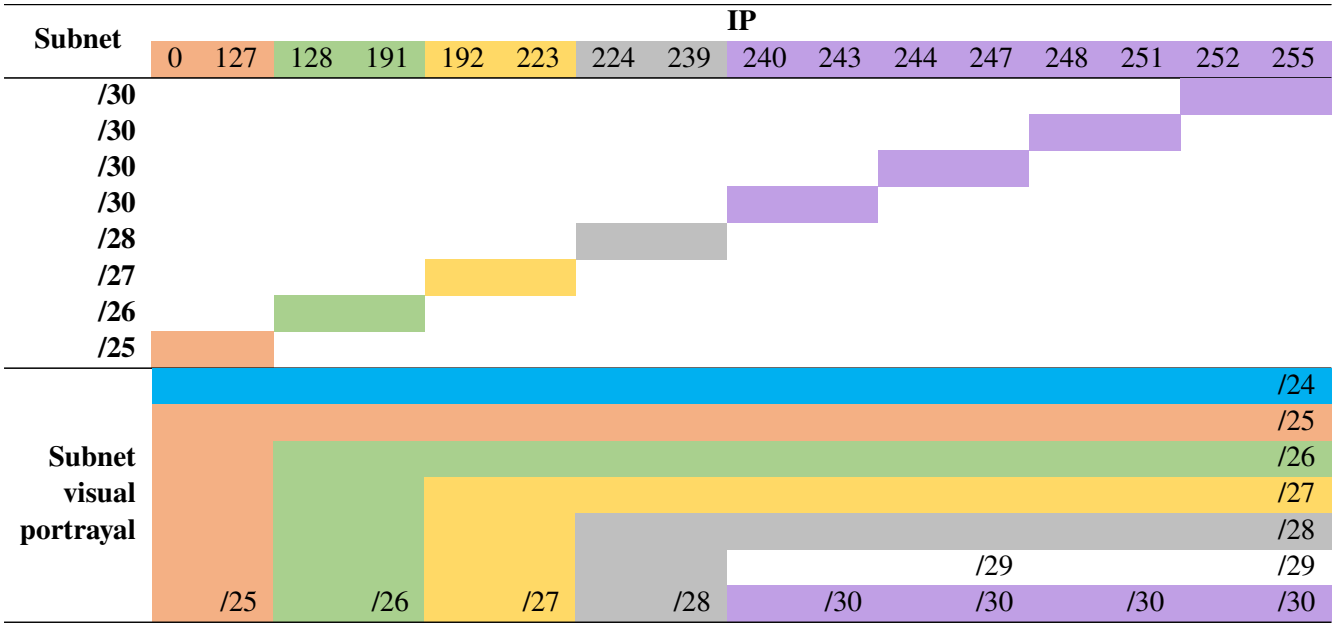

Table 2.1: Visual LAN allocation

Name	Network	Usable IPs	Router	Broadcast	Subnet Mask	Populated
	192.168.7.				255.255.255.	
LAN Transit A	252	253 - 254		255	252	2
LAN Transit B	248	249 - 250		251	252	2
LAN Transit C	244	245 - 246		247	252	2
Unused	240	241 - 242		243		0
remaining	224	225 - 238		239		0
LAN B	192	193 - 221	222	223	224	27
LAN A	128	129 - 189	190	191	192	48
LAN Server	0	1 - 125	126	127	128	126

Table 2.2: LAN allocation table

Name	Ports Link		Network	IP	Gateway	Subnet Mask
	From	To		192.168.7.		255.255.255.
PC0	Fa0	Sw0 Fa0/2	LAN A	129	190	192
Laptop0	Fa0	Sw0 Fa0/3		130		
PC1	Fa0	Sw1 Fa0/2	LAN B	193	223	224
Laptop1	Fa0	Sw1 Fa0/3		194		
R0	Fa5/0	R1 Fa5/0	LAN Transit B	249		252
	Fa4/0	R2 Fa4/0	LAN Transit C	245		
	Fa0/0	Fa0/0	External			
R1	Fa4/0	R2 Fa5/0	LAN Transit A	253		252
	Fa5/0	R1 Fa4/0	LAN Transit B	250		

Table 2.3 continued from previous page

Name	Ports Link		Network	IP	Gateway	Subnet Mask
	From	To		192.168.7.		255.255.255.
	Fa0/0	Sw0 Fa0/1	LAN A	190		192
	Fa1/0	Sw1 Fa0/1	LAN B	222		224
	Fa5/0	R1 Fa4/0	LAN Transit A	254		252
R2	Fa4/0	R0 Fa4/0	LAN Transit C	246		
	Fa0/0	Sw2 Fa0/4	LAN Server	126		128
DHCP Server	Fa0	Sw2 Fa0/3		1		
DNS Server	Fa0	Sw2 Fa0/2	LAN Server	2	126	128
HTTP Server	Fa0	Sw2 Fa0/1		3		
	Fa0/1	R1 Fa0/0				
Sw0	Fa0/2	PC0	LAN A			
	Fa0/3	Laptop0				
	Fa0/1	R1 Fa1/0				
Sw1	Fa0/2	PC1	LAN B			
	Fa0/3	Laptop1				
	Fa0/1	HTTP				
Sw2	Fa0/2	DNS	LAN Server			
	Fa0/3	DHCP				
	Fa0/4	R2 Fa0/0				

Table 2.3: IP configuration table

Router	From	To	Network	Via	Through
R1	LAN A / LAN B	LAN Servers	192.168.7.0/25	192.168.7.254	R1 > R2
		Any	8.8.8.8/30	192.168.7.249	R1 > R0
R2	LAN Servers	LAN A	192.168.7.128/26	192.168.7.253	R2 > R1
		LAN B	192.168.7.192/27		
		Any	8.8.8.8/30	192.168.7.245	R2 > R0
R0	Any	LAN A	192.168.7.128/26	192.168.7.250	R0 > R1
		LAN B	192.168.7.192/27		
		LAN Servers	192.168.7.0/25	192.168.7.246	R0 > R2

Table 2.4: Static routes table

Connecting to devices was pretty straight forward. Now comes the expected progress. What follows next tackles a network approach paramount for the next four phases.

$$Clients_{LAN_A} = max\left(20, \left(\sum_{k=0}^{n} studentnumber_k\right) mod 100\right) \quad <=> Clients_{LAN_A} = 48$$

$$Clients_{LAN_B} = \frac{Clients_{LAN_A}}{2} \quad <=> Clients_{LAN_B} = 27$$

Using the required mathmatical equations, provided in the project, we reach the conclusions presented in the following tables.

Chapter 3

Issues and fixes

Cisco Packet Tracer in MacOS:

No solution was found to deal with those annoying popups that takes primary focus over other windows, even using the latest version.

Chapter 4

Conclusions

By testing first with a switch we understood how arp tables work, storing it's information in devices since layered 2 equipments don't provide that functionality. Right after we got to put that argument to the test by using a router to connect to two distinct LANs. And it checks out, layered 3 devices store arp tables, displaying only their gateways through tracert (traceroute).

Appendix A

Appendix