INFRASTRUCTURE REPORT

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Made by:

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An Infrastructure Report to be Submitted to the School of Information and Communication Technology at

Fontys University of Applied sciences

Table Of Contents

CHAPTER ONE

INTRODUCTION ABOUT STUDENT

I am Baluku Joseph, a first year student ,semester One doing a bachelors degree in Information and communication Technology at Fontys University School of Applied Science. I attend to PC05, and among the course unit we had in the First 11 weeks , we studied ICT and Infrastructure, which is about being about being to manage the existing IT infrastructure in all its facets and being able to design and realise a new infrastructure. I enjoyed being taught by Mr. Metaxas and then later Mr. Vladimir and I am happy I was so far I was introduced the introductory basics of the course.

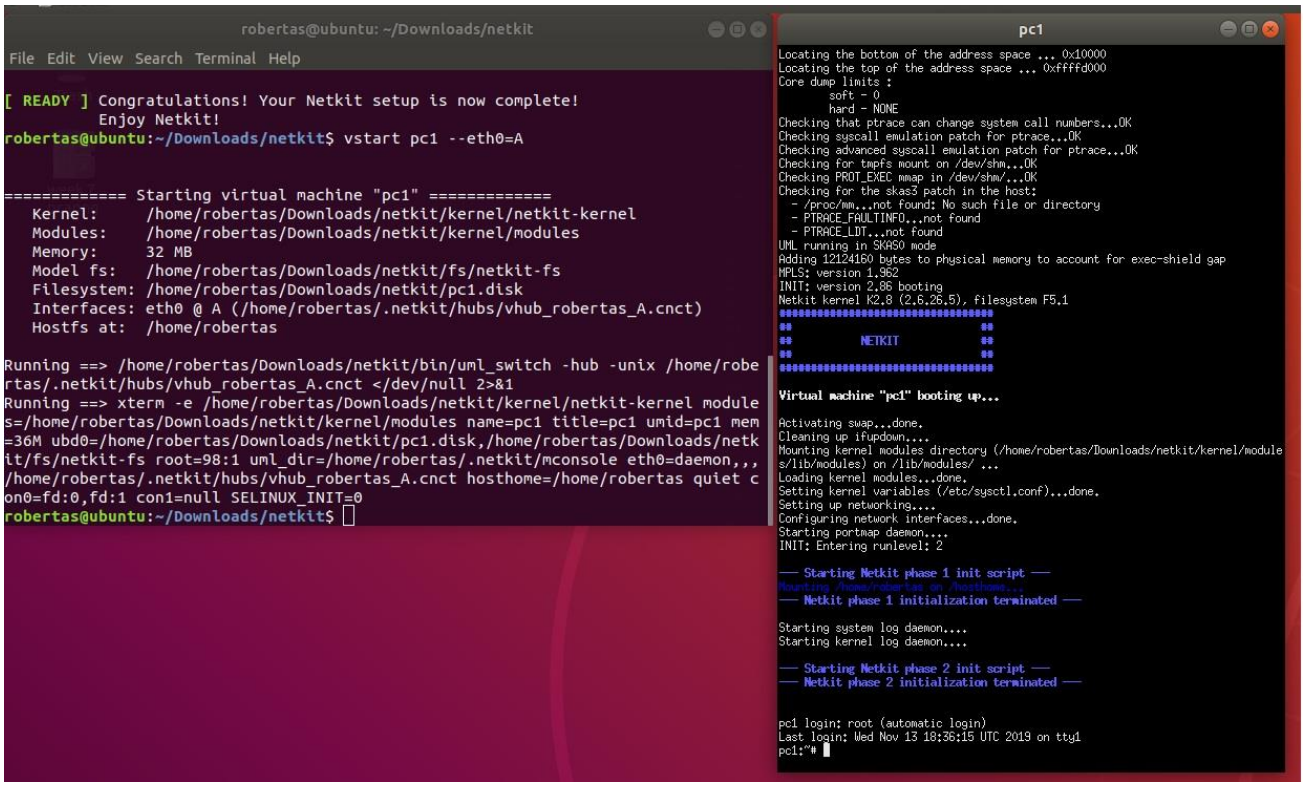
CHAPTER TWO : NETWORK BASICS WEEK 7

INVESTIGATION OF HARDWARE

Task 1: install and Test Netkit Tool

Consult this week's theory presentation and use the Netkit commands to start and halt a network node as described in the presentation. Netkity and Wireshark are already installed in the preconfigured Linux. If you installed the Linux yourself, then you need to install these tools yourself. (there is a guideline in the Canvas)

Provide screenshot of the started node.



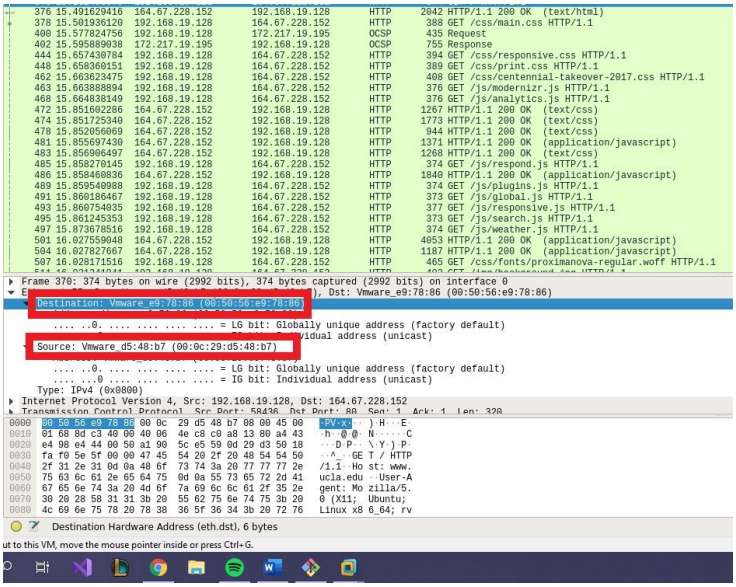
Task 2: TCP/IP Layers in Wireshark

Find a Wireshark Tutorial on the web. Run Wireshark.

Start capturing the network traffic. To generate HTTP traffic, go to some web page with your web browser (e.g. www.fontys.nl). Don't forget to stop capturing as you can get a lot of traffic in your capture. Look at your captured packets and find an HTTP GET packet and Answer the following questions and provide the screenshots:

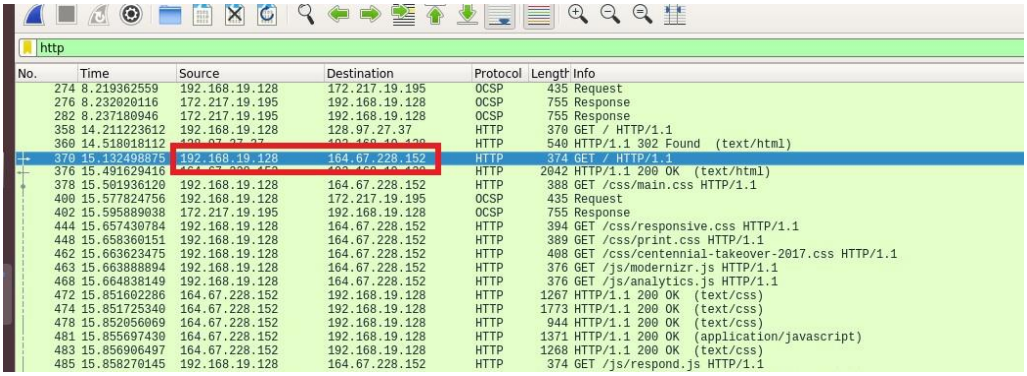
- What is the source and destination MAC address of this HTTP packet? Provide a screenshot to prove it

  The source MAC address is 00:0c:29:d5:48:b7 and the destination MAC address is 00:50:56:e9:78:86

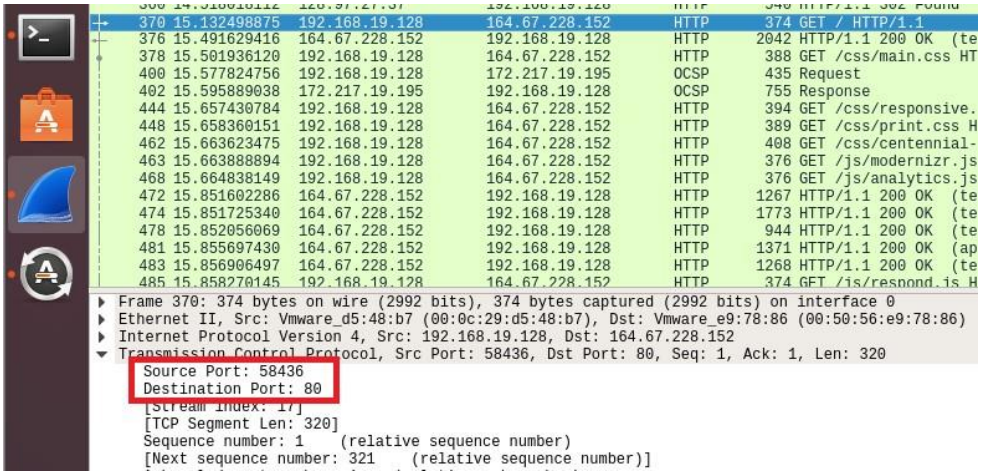


- What is the source and destination IP address of this HTTP packet? Provide a screenshot to prove it

  The source IP address is 192.168.19.128 and the destination address is 164.67.228.152



- What is the source and destination port of this HTTP packet? Provide a screenshot to prove it
  Source port is 58436 and destination port is 80



- What is the host name of this HTTP Get packet?
  www.ucla.edu\r\n

- Find the HTTP Response belonging to the HTTP Get packet. How much time elapsed between the HTTP Get and HTTP response?
  Around 0.36 seconds elapsed between the request and response.

Task 3: Do Linux Tutorial

Go to http://www.ee.surrey.ac.uk/Teaching/Unix/index.html and do the tutorial three.

Provide screenshots of all exercises in section 3.4

CHAPTER THREE : INTERNET PROTOCOL WEEK 8

LINUX, STATIC IP ADDRESS / SUBNET CONFIGURATION

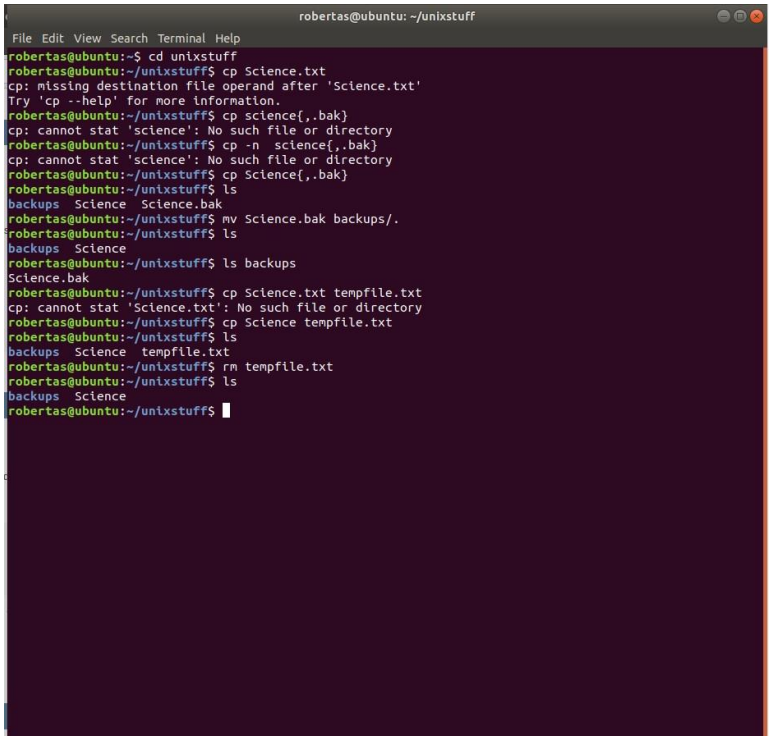
LINUX, STATIC IP ADDRESS/SUBNETS CONFIGURATION

Task 1a: Do Linux Tutorial

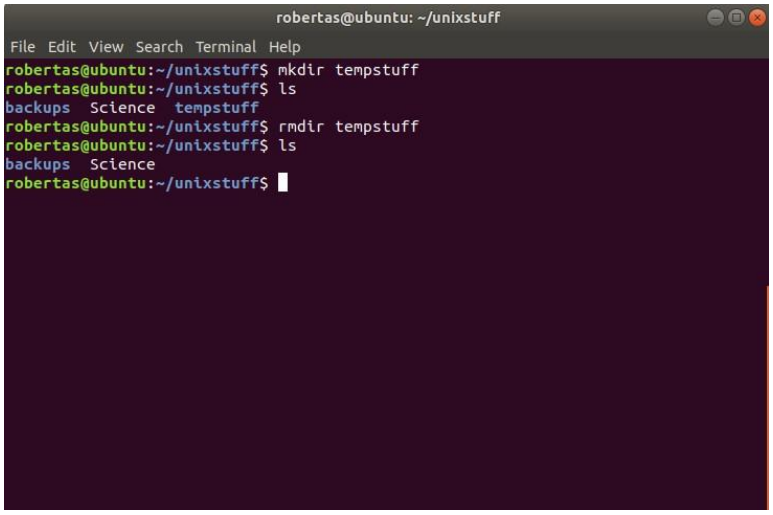
Go to http://www.ee.surrey.ac.uk/Teaching/Unix/unix2.html and do the 2nd basic Unix tutorial.

Provide screenshots of all exercises 2a and 2b. Do all subsections of this tutorial – all of them are really useful! This task should be done individually, so each member of the team should provide his/her evidence(screenshots).

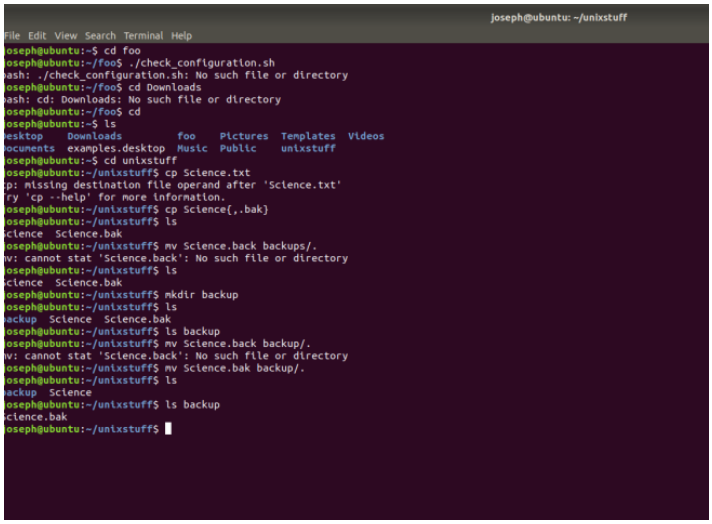
2a



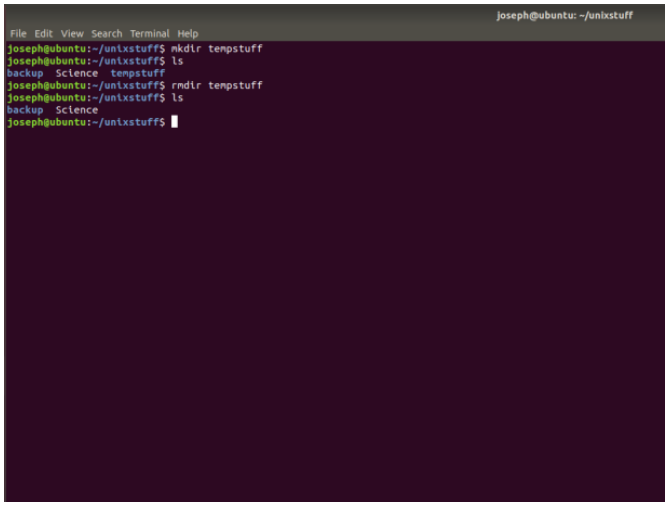
2b


robertas@ubuntu: ~/unixstuff
File Edit View Search Terminal Help
robertas@ubuntu:~/unixstuff$ mkdir tempstuff
robertas@ubuntu:~/unixstuff$ ls
backups Science tempstuff
robertas@ubuntu:~/unixstuff$ rmdir tempstuff
robertas@ubuntu:~/unixstuff$ ls
backups Science
robertas@ubuntu:~/unixstuff$

2a


joseph@ubuntu: ~/unixstuff
File Edit View Search Terminal Help
joseph@ubuntu:~$ cd foo
joseph@ubuntu:~/foo$ ./check_configuration.sh
bash: ./check_configuration.sh: No such file or directory
joseph@ubuntu:~/foo$ cd Downloads
bash: cd: Downloads: No such file or directory
joseph@ubuntu:~/foo$ cd
joseph@ubuntu:~$ ls
Desktop Downloads foo Pictures Templates Videos
Documents examples.desktop Music Public unixstuff
joseph@ubuntu:~$ cd unixstuff
joseph@ubuntu:~/unixstuff$ cp Science.txt
cp: missing destination file operand after 'Science.txt'
Try 'cp --help' for more information.
joseph@ubuntu:~/unixstuff$ cp Science{,.bak}
joseph@ubuntu:~/unixstuff$ ls
Science Science.bak
joseph@ubuntu:~/unixstuff$ mv Science.back backups/.
mv: cannot stat 'Science.back': No such file or directory
joseph@ubuntu:~/unixstuff$ ls
Science Science.bak
joseph@ubuntu:~/unixstuff$ mkdir backup
joseph@ubuntu:~/unixstuff$ ls
backup Science Science.bak
joseph@ubuntu:~/unixstuff$ ls backup
joseph@ubuntu:~/unixstuff$ mv Science.back backup/.
mv: cannot stat 'Science.back': No such file or directory
joseph@ubuntu:~/unixstuff$ mv Science.bak backup/.
joseph@ubuntu:~/unixstuff$ ls
backup Science
joseph@ubuntu:~/unixstuff$ ls backup
Science.bak
joseph@ubuntu:~/unixstuff$

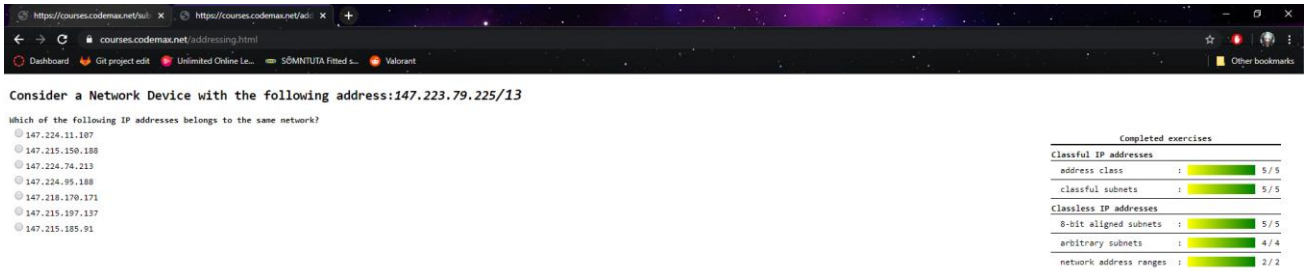
2b



***Task 1b**: Networking exercise*

Do the netwoerking online exercises via this link https://courses.codemax.net/w8.html.

Provide screenshots of all exercises.



Task 2: *Build A Simple Netkit Network*

Read the explanation of the basic Netkit commands and use them to build a simple network of two nodes connected to a LAN interface.

Try the following configurations:

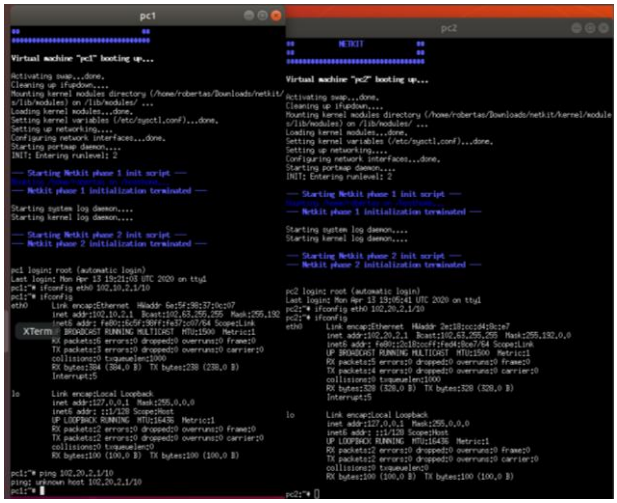
A) Configure the IP addresses of the 2 nodes by using the “ifconfig” command explained in the theory lesson.

1. Node1 has an IP address 102.10.2.1/24
2. Node2 has an IP address 102.20.2.1/24

Check whether your configuration was successful by using ping command between these two nodes.

1. What is the result of the ping? Can you explain it? Provide a screenshot.

   “Network is unreachable” The Node1 cannot reach Node2 since their Network id does not match



2. Look at the ARP entries of your Node1 and Node2. Which command do you use? Which ARP entries are there?

   There are no ARP entries because the ping didn’t work.

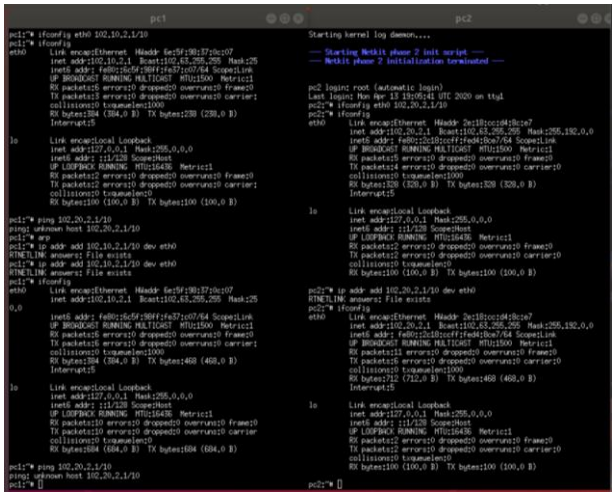
B) Configure the IP addresses of the 2 nodes by using the “ip” command explained in the theory lesson.

1. Node1 has an IP address 102.10.2.1/10
2. Node2 has an IP address 102.20.2.1/10

Check whether your configuration was successful by using ping command between these two nodes.

1. What is the result of the ping? Can you explain it? Provide a screenshot of your configured interfaces.

   “Network is unreachable” The Node1 cannot reach Node2 since their Network id does not match

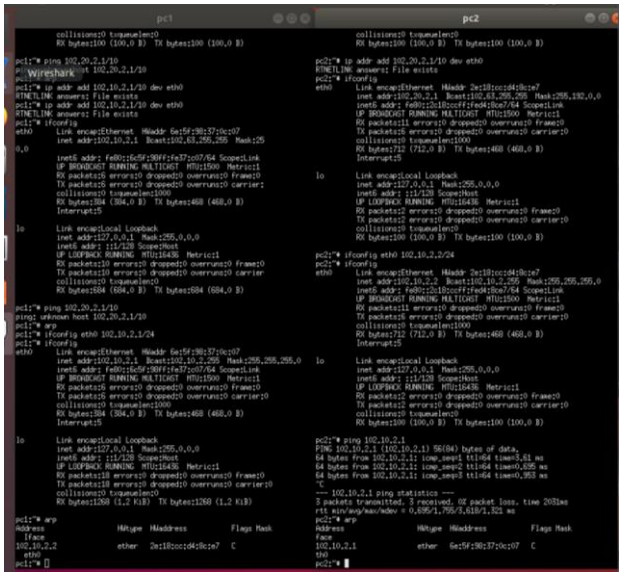


2. Look at the ARP entries of your Node1 and Node2. Which ARP entries are there?

   There are no ARP entries because the ping didn’t work

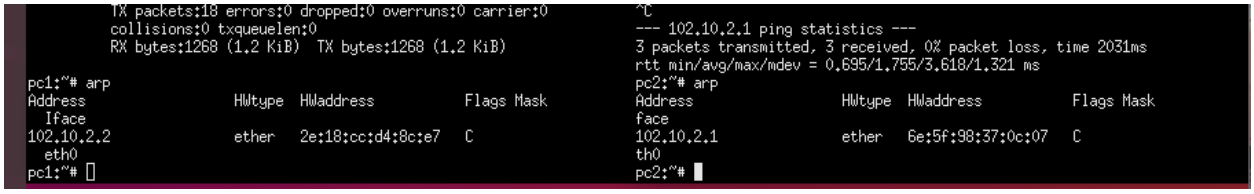
C) Configure both nodes to have a subnet mask 255.255.255.0, and change the IP address of Node2 in such a way that the ping between them is successful.

1. Provide a screenshot of your configuration and successful ping.



3. After successful ping ARP entries of both nodes should be changed. Provide a screenshot of the new ARP situation and explain it. What is the command to clear the ARP cache again?

   Pc2 sent a ping to pc1 and pc1 gave information back to the pc2. The command to delete ARP entries is arp -s



Task 3: Configuring Network

For this assignment you can use a preconfigured netkit lab provided in net_routing.zip file. To do this you need to copy the provided zip file somewhere in your Linux environment, e.g. in ~/netkit_labs. Unzip the file. You have now a preconfigured lab Deliver the lab network of this task in your *git* project. *Thus, when you are done write below the URL of your git project (I should be able to access your results using "git clone" and the provided git URL).*

Each simulated node has its own directory. Also, each simulated node has a <node>.startup file where any commands can be added that should be executed before startup of the node.

To start the lab issue the following command in the root directory of your lab:

lstart

Note: When you issue this command, you'll be prompted for a password which in your case is **student**.

Netkit uses the file "labs.conf" in order to initialize the Ethernet devices and their respective collision domains for each node. For example inside the labs.conf there is a line "RouterAC[0]=LANA" and a line "RouterAC[1]=LANC".
These two lines have same effect when the node "RouterAC" is initialized, as if we would run the command:
"*vstart RouterAC --eth0=LANA --eth1=LANC*".

Now all the nodes should be started. However, the nodes are not configured yet. You need to configure them as follows:
Configure the Ethernet devices connected via the collision domain LANA using the IP range 10.X.0.0/16, where X is the number of your pair/group.

Configure the Ethernet devices connected via the collision domain LANB using the IP range 172.16.X.0/24, where X is the number of your pair/group.

Configure the Ethernet devices connected via the collision domain LANC using the IP range 192.168.X.0/24, where X is the number of your pair/group.

For example if your group number is 230 you should use IP address from the range 10.230.0.0/16 for LANA, 172.16.230.0/24 for LANB and 192.168.230.0/24. (see also table 1).

There are 2 ways to configure your interfaces. *We recommend you all use the first option and for your own experiment you can use the second option but make sure all your submissions follow the first option:*

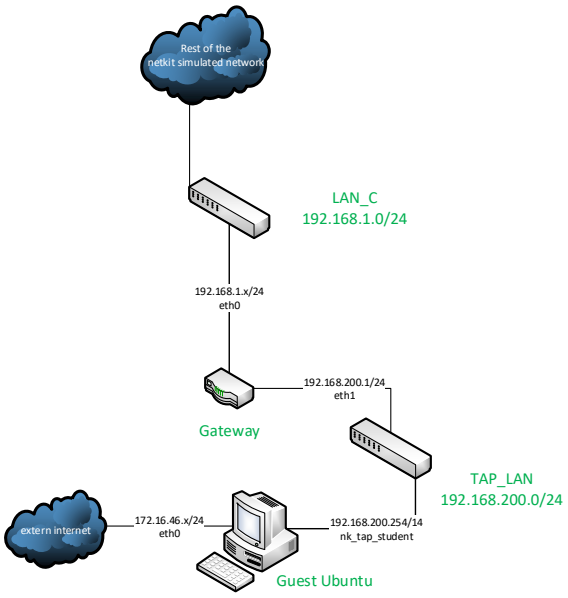
1. Use either ifconfig or ip commands. Once you know how the commands should look like, it is highly recommended to put them in <node>.startup files, so next time you want to restart and present your lab, you don't have to reconfigure it by hand again. Note : Please don't remove the commands which are already present in the <node>.startup files. They are necessary for starting up Linux networking service.

2. Use <node>/etc/network/interfaces file of the node you want to configure.

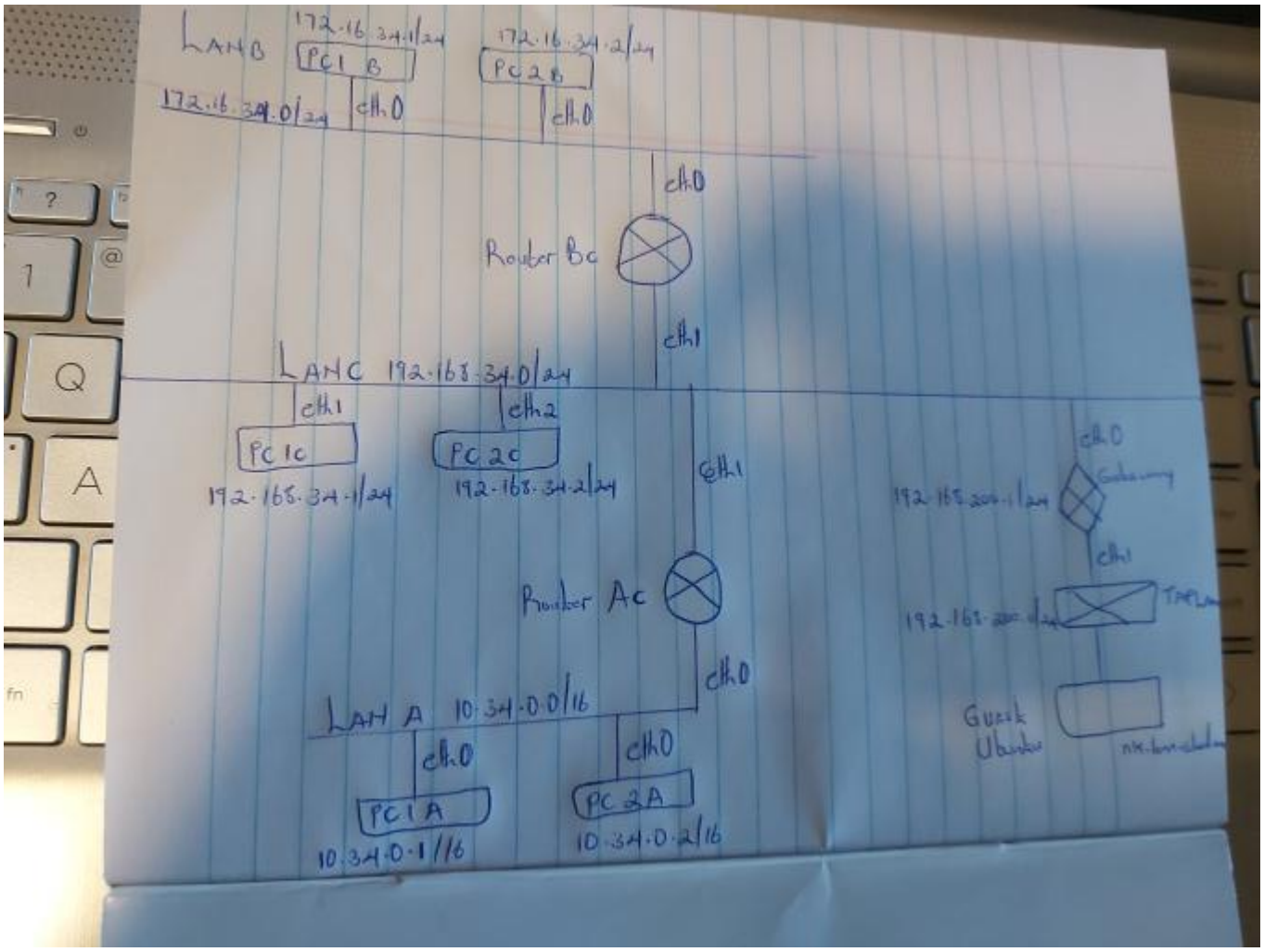
In the netkit lab environment you can put any files the contents of which you want to see in the simulated node in the <node> directory. In this way, you can also put there <node>/etc/network/interfaces file. This file is used by Linux system to configure the network interfaces. An example of such a file is provided in the lab for PC1A node.

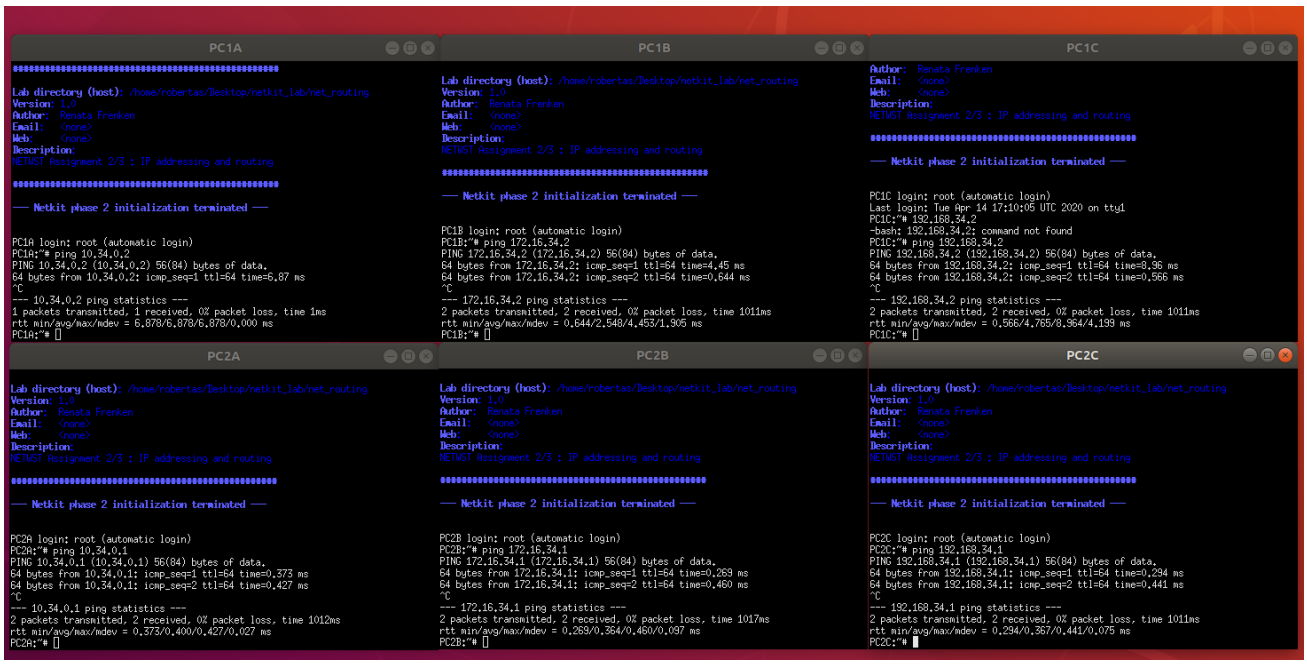
The network of the lab is as follows:

1. PC1A, PC2A and RouterAC are connected to LANA
2. PC1B, PC2B and RouterBC are connected to LANB
3. PC1C, PC2C, RouterBC, RouterAC and Gateway are connected to LANC
4. Gateway is connected to LANC through fixed eth0 interface with IP address 192.168.1.x/24 and to TAP_LAN through eth1 interface with IP address 192.168.200.1. The TAP_LAN is a Netkit-specific interface used for the connection to your guest Linux system. The Gateway node will be used for the optional part of the Assignment 3.
5. Your guest Linux system is connected to your simulated Netkit node Gateway through Netkit specific tap interface nk_tap_student 192.168.200.254, see the detail of the connection between the Netkit simulated environment and your Guest machine in the picture below.



Provide the network drawing *of your lab network you can use* https://app.diagrams.net/ *and screenshots of the pings which are possible WITHIN LANA, LANB and LANC (PC1A to PC2A, PC1B to PC2B and so on). When creating* the *network drawing, don't forget to mention* the *IP addresses/subnet masks for all nodes of your network. It is also useful to include the names of the network interfaces (eth0, eth1, …).*





You don’t need to be able to route between all nodes of this network; that is the second part of the assignment, which will be done next week. 10

Note 1: In the provided netkit lab there are files HOWTO, interfaces.example and Example.startup which can give you more info on how to use and configure the lab.

Table 1 : IPv4 address ranges per student group

Group	LANA	LANB	LANC
1	10.1.0.0/16	172.16.1.0/24	192.168.1.0/24
2	10.2.0.0/16	172.16.2.0/24	192.168.2.0/24
…			
n	10.n.0.0/16	172.16.n.0/24	192.168.n.0/24

Task 4: CIDR IP Addressing Exercises

1. Suppose we have IP address 122.33.196.145/24

Fill in the following items for this address:

1. Network Address
   122.33.196.0
2. Broadcast Address
   122.33.196.255
3. Subnet Mask
   255.255.255.0

2. Suppose we have IP address 163.249.223.229/25

Fill in the following items for this address:

1. Network Address
   163.249.223.129/25
2. First Host
   163.249.223.129
3. Last Host
   163.249.223.254
4. Broadcast Address
   163.249.223.255

Chapter Four :- Routing Week 9

IP Routing

Task 1: A bit more complex network: Part 2

Last week you did the configuration of your IP network for the preconfigured lab.

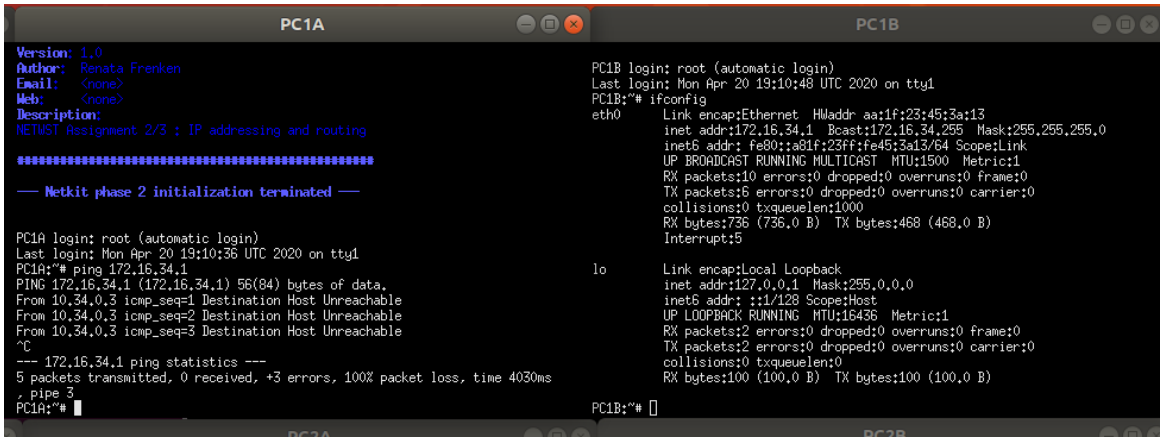
If you have done well and used either scripts or network/interfaces files, you should be able to restart your configured environment again. Also, you should have a drawing of your network.

Your task is adding routing information to your nodes in such a way, that every node of your network should be able to ping any other node of your network. The routes should be optimal, so the shortest path from node to node should be used. To implement routing, you'll have to use different types of routes as learned on the theory lesson.

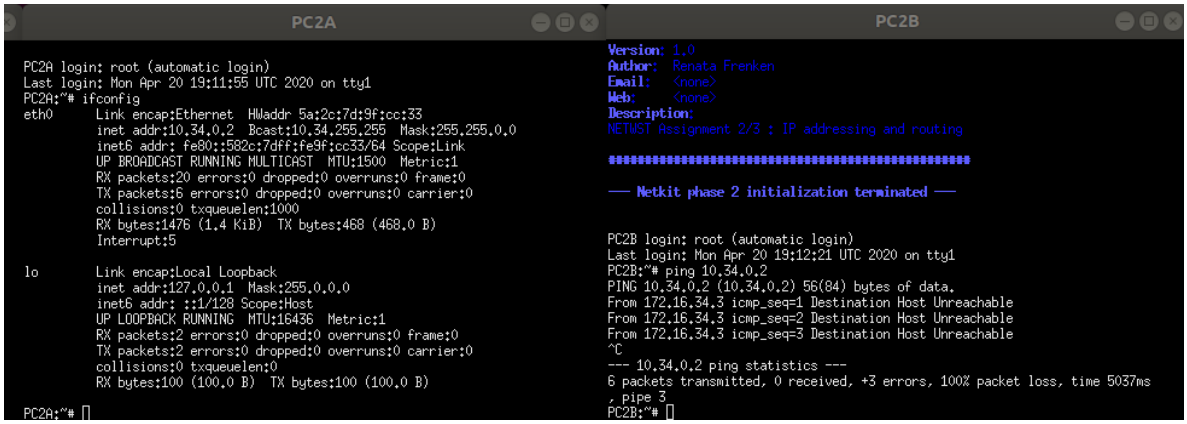
Tip: Use the network drawing from the last week assignment (week 8) and first think about the way you're going to route. Use ***tcpdump*** *and* ***traceroute*** *commands to debug your routing.*

Provide screenshots of the following pings:

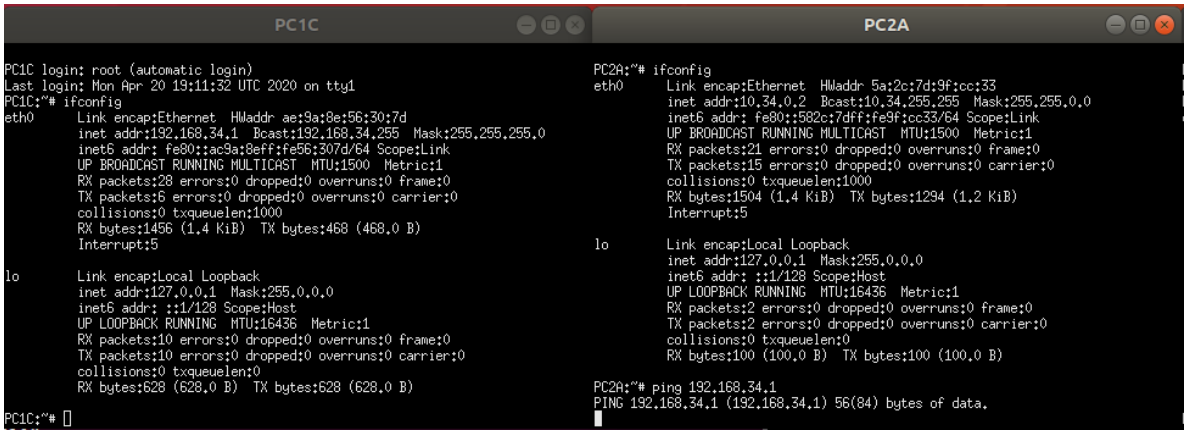
1. *PC1A to PC1B*



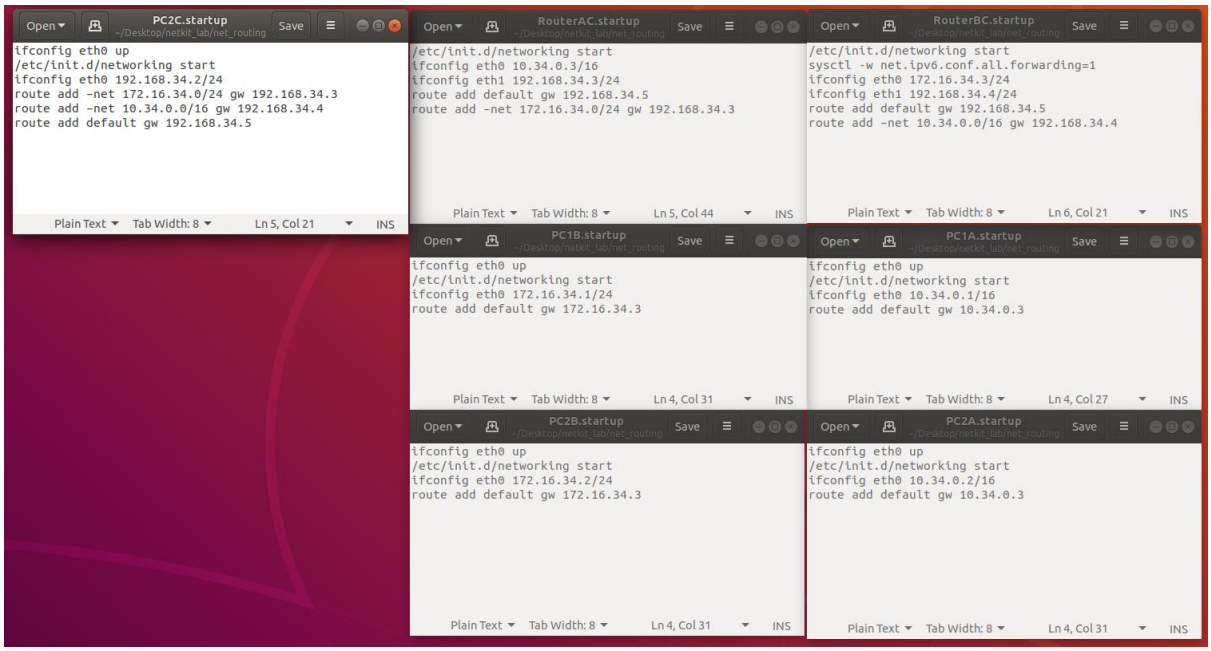
2. *PC2B to PC2A*



3. *PC2A to PC1C*

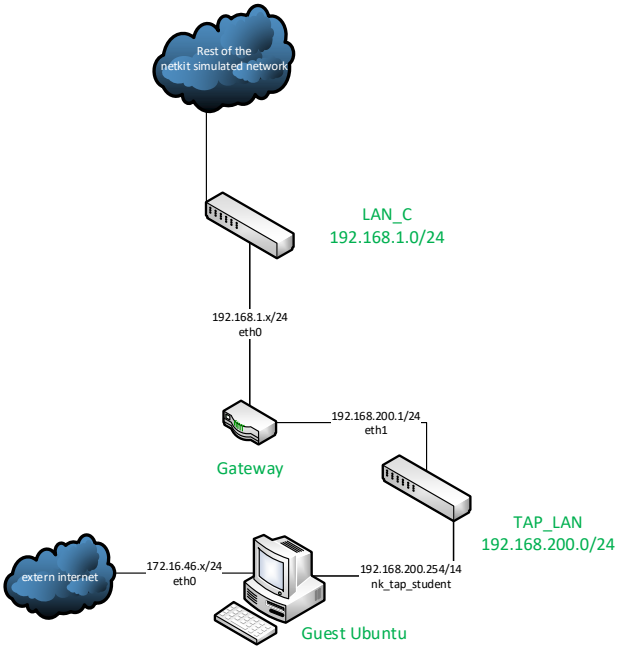


Give a list of all nodes where you had to adjust the routing tables and the screenshots of their configured routing tables.



Task 2 (Optional): Access the outside world

The provided lab has also an interface outside of the Netkit to your host Linux machine, so called Netkit tap interface. To use this interface you need to use node Gateway, which is connected with one interface to LANC and with the other (tap) interface to your guest Linux system which is then connected to the outside world. The schematics of this interface is:



Configure your network in such a way that you can reach a node on Internet.

To prove your correct configuration you should be able to ping a host like 8.8.8.8 (Google DNS server) from any node on your network.

Provide screenshots of the following ping:

PC1A to 8.8.8.8, PC1B to 8.8.8.8

Table 2 : IPv4 address ranges per pair

Pair	*LANA*	*LANB*	*LANC*
1	*10.1.0.0/16*	*172.16.1.0/24*	*192.168.1.0/24*
2	*10.2.0.0/16*	*172.16.2.0/24*	*192.168.2.0/24*
3	*10.3.0.0/16*	*172.16.3.0/24*	*192.168.3.0/24*
4	*10.4.0.0/16*	*172.16.4.0/24*	*192.168.4.0/24*
5	*10.5.0.0/16*	*172.16.5.0/24*	*192.168.5.0/24*
6	*10.6.0.0/16*	*172.16.6.0/24*	*192.168.6.0/24*
7	*10.7.0.0/16*	*172.16.7.0/24*	*192.168.7.0/24*
8	*10.8.0.0/16*	*172.16.8.0/24*	*192.168.8.0/24*
9	*10.9.0.0/16*	*172.16.9.0/24*	*192.168.9.0/24*
10	*10.10.0.0/16*	*172.16.10.0/24*	*192.168.10.0/24*
11	*10.11.0.0/16*	*172.16.11.0/24*	*192.168.11.0/24*
12	*10.12.0.0/16*	*172.16.12.0/24*	*192.168.12.0/24*
13	*10.13.0.0/16*	*172.16.13.0/24*	*192.168.13.0/24*
14	*10.14.0.0/16*	*172.16.14.0/24*	*192.168.14.0/24*
15	*10.15.0.0/16*	*172.16.15.0/24*	*192.168.15.0/24*

CHAPTER FIVE : TCP/UDP WEEK 10

TCP/UDP

Task 1: TCP in Netcat

To do this assignment we will use the Netcat tool which is provided in the Netkit. Netcat makes it possible to create and use TCP/UDP connections. If you want more info about Netcat you can consult Internet. To make this assignment we will reuse the net_routing lab from the previous assignments. Let's start a chat session by connecting 2 netcat instances via a TCP connection.

To listen to the TCP connections, go to one of your simulated nodes (e.g. PC1A) and issue the following command:

nc –l –p <port_nr>

This will make netcat listen to port number that you have specified in port_nr and accept connections.

Note: Any port number would be ok, as long as it is not used by another application.

To establish a TCP connection you can issue the following command from another simulated node (e.g. PC1C)

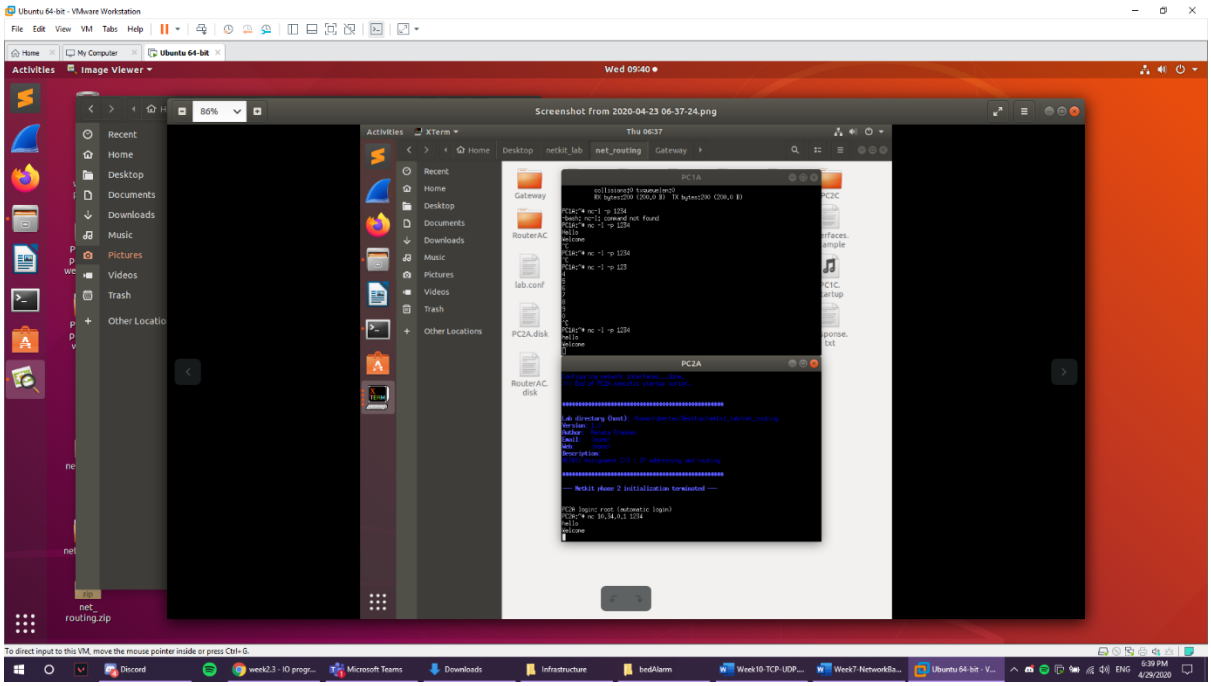
- ***nc <IP address of the "listening" node> <port_nr of the "listening node">***

This will make a TCP connection with the listening netcat instance.Now you can chat from one netcat instance to the another. Try it out!

Your task:

- *Netcat can also be used to copy the contents of a file from one place (file, folder, computer) to another. Find out how and try it out.*

Provide screenshots of the sending and receiving command.



Let's now build a basic one-page webserver using netcat.

As a first step create a textfile 'response.txt' with following content:

> ***HTTP/1.1 200 OK***
>
> ***Content-Type: text/html;***
>
> ***Content-Length: 12***
>
> ***Connection: close***
>
> ***Hello World!***

This is a proper HTTP response.

You are going to simulate HTTP server and HTTP client (browser) using netcat. You are going to use Gateway node for running HTTP client (browser), see section below about how to install links browser on Gateway before you start the exercise. You are going to use any node of your network (e.g. PC2C) to simulate HTTP server.

Your task:

Construct an appropriate netcat command to listen to a port on your HTTP server (e.g. PC2C) and send the contents of the file response.txt to the HTTP client (Gateway) when a connection is made to this port. That is roughly what a webserver does too.
You can test it by entering the following URL in links browser on Gateway.

http://<IP_ADDRESS_OF_WEBSERVER>:<port_nr>

If everything works well the links should show the "Hello World" webpage.

Links installation:

Before starting this task, you have to install links text-mode web browser. Follow these steps:

- *Go to your lab's Gateway directory. Create etc subdirectory and create there a resolv.conf text file with the following contents:*
  nameserver 8.8.8.8
  search localdomain

- *Start your lab. Now you should be able to connect to the Internet, so do the following installation on the Gateway node:*
  apt-get install links

Now the links web browser should be available on your Gateway node. Watch out, once you stop your Gateway node, you have to do 'apt-get install links' command again to install links.

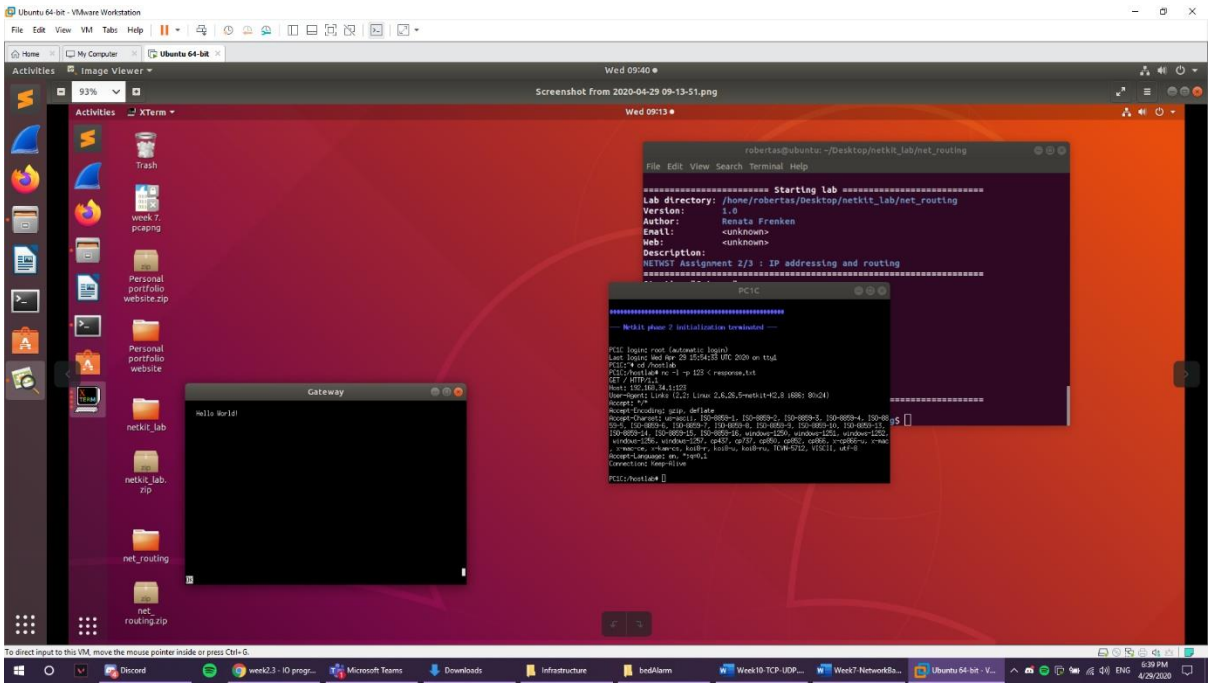
Note1: You can start links browser by issuing this command:

links

To be able to enter the URL in links browser press "G".

Note2 : You can put the response.txt file in your net_routing directory ***before*** *start of the lab (lstart command).* ***After*** *starting the lab, you can find this file in the /hostlab directory of your node.*

Provide a screenshot of the netcat command you used and of the links browser output.

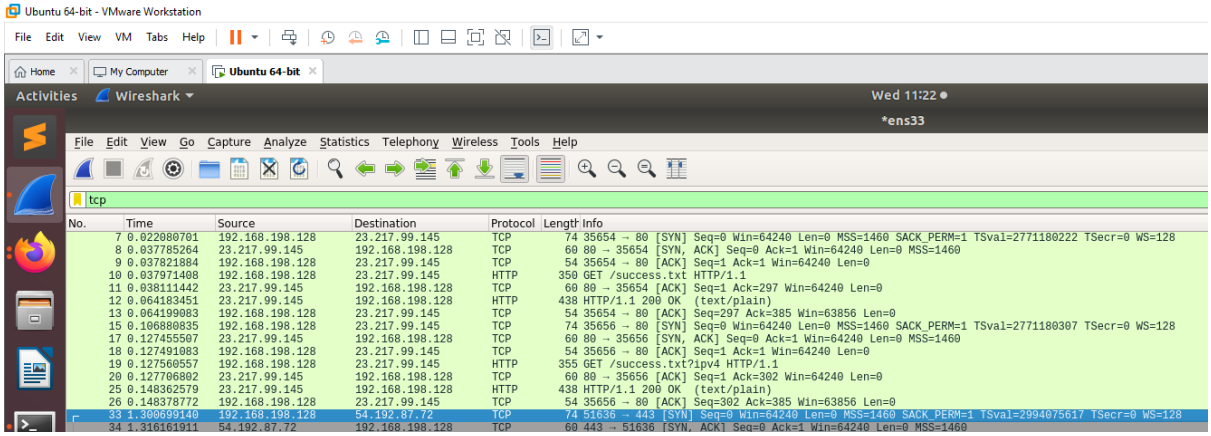


Task 2: Find 2 TCP uses

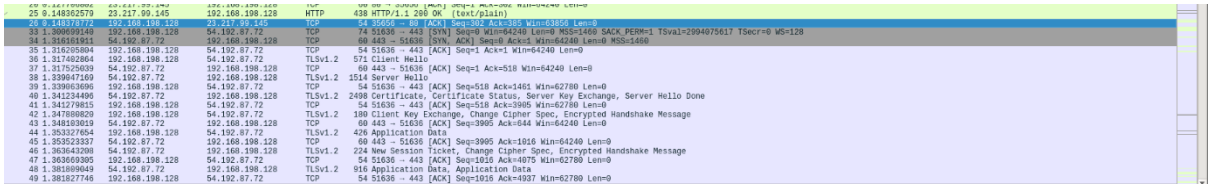
Think about two different scenarios for TCP use that you can simulate (you can do this on your own PC, so you don't need Ubuntu for this). Start a Wireshark trace for both scenarios.

Describe the chosen scenarios and a proof of TCP use in them by attaching a Wireshark trace showing TCP packets.

1. *To get access to a website the TCP packets are used*



2. *To communicate with the server of a website or online application and receive access or deny access TCP packets are used.*



Choose one of the 2 scenarios traces and browse it in the Wireshark. Select 'Statistics > Flow Graph' and then choose flowtype 'TCP flow' to draw a Sequence Diagram of the TCP message interaction that you see in Wireshark.

Provide a screenshot of this Flow Graph.

Explain what is happening during various stages (begin, middle, end) of the communication. Explain SYN, SYNACK and ACK. Explain the Len, Seq and Ack numbers.

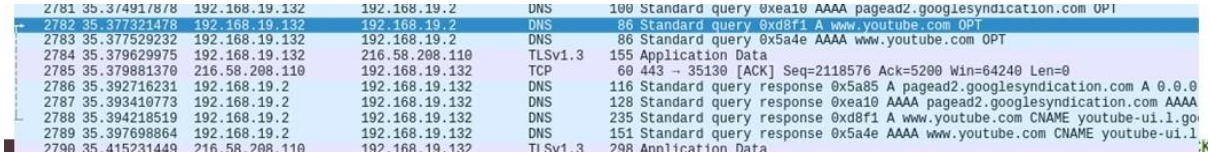
I captured packets from connecting to https://www.cnet.com/news/, the connection was started by three way handshake and it was also terminated by three way handshake

Task 3: Find 2 UDP uses

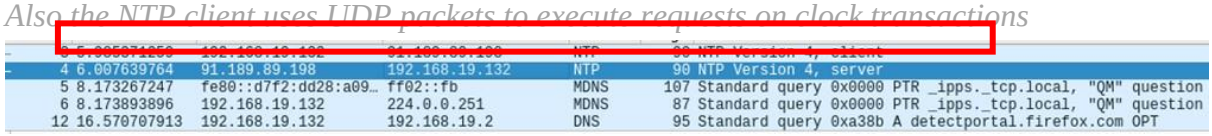
Think about two different scenarios for UDP use that you can simulate (you can do this on your own PC, so you don't need Ubuntu for this). Start a Wireshark trace for both scenarios.

Describe the chosen scenarios and a proof of UDP use in them by attaching a Wireshark trace showing UDP packets.

A. *I went to Youtube and I got a DNS server request to open the url www.youtube.com DNS server uses UDP packets to execute requests*



B. *Also the NTP client uses UDP packets to execute requests on clock transactions*



Task 4 (Optional): TCP SYN Flooding

Read an explanation of TCP SYN Flooding at http://en.wikipedia.org/wiki/SYN_flood or from some other source.

In this task you're going to simulate this kind of DDOS attack that uses vulnerability of TCP protocol.

For this experiment you can reuse net_routing lab. You can use for example the PC1B node as the victim and RouterAC node as an attacker.

To be able to wait for the TCP connections, use netcat command to wait for the TCP connections on a specific port at the victim node.

To simulate TCP SYN flood traffic from the attacker node, you can use the "hping3" tool which is part of your netkit nodes.

Before you start the attacker command, don't forget to sniff the traffic with tcpdump command and write the output to a pcap file:

tcpdump –w <filename>.pcap –s 0

Tip: If you want to run tcpdump or any other command in the background you can do it by specifying "&" at the end of the command. In this way you can use your Linux prompt again. To see all your background processes use "jobs" command and to put a job in foreground again use : "fg <job_number>".

A command to be issued at the attacker node can look like:

hping3 --rand-source <IP_ADDRESS_OF_VICTIM> --flood –S –L 0 –p <PORT_NR_OF_VICTIM>.

Wait about 10 seconds, stop hping3 and tracing.

Now you should be able to analyze the trace. You should be able to see spoofed source IP address.

Analyze your trace. Find out how many SYNs, SYN+ACKs and ACKs you can see. Explain what do these numbers tell you about SYN attack.

Consult internet to find out how another transport protocol – SCTP - solves TCP SYN flooding problem. Give a short explanation of how it is implemented in SCTP.

CHAPTER SIX :

CONCLUSION

My week seven to week Ten study assignments for infrastructure are all compiled and contained in this document. I enjoyed working together with my groupmate Robertas and Group 34. It has been not easy to meet up as it would be if school was open but I am glad we always made time to go into teams and do the assignments and I am grateful for Mr. Vladimir who have been always there to help us whenever we had questions to ask him, or when we sent him emails he was responsive. I appreciate being introduced to the basics of networking in this semester and I am thankful for my good teacher who was still available in this Corona era where classes have been closed.

CHAPTER SEVEN :

PERSONAL REFRACTION

I appreciate so much having been introduced to the basics of networking , but I wish there was no corona all over the world , and I get the basics more practically , we used to do the work using Wireshark and Ubuntu and wished if the school laboratories where open for us to go in there and have a more feel of what I was doing. I have learnt new things I never knew but I still miss that laboratory feel. But it stands now I say I am no more illiterate about networking at list I have the beginners knowledge and I am proud of myself about that.