universidade de aveiro
theoria poiesis praxis

DEPARTAMENTO DE ELECTRÓNICA, TELECOMUNICAÇÕES E INFORMÁTICA
LICENCIATURA EM ENG. DE COMPUTADORES E INFORMÁTICA

REDES DE COMUNICAÇÕES I

LAB GUIDE

TRANSPORT PROTOCOLS, SERVICES AND APPLICATIONS

Objectives

- Study of UDP and TCP transport protocols.
- Service deployment and study of DNS, HTTP, TFTP and FTP

Duration

- 2 weeks

1. VirtualBox Virtual Machines

If you do not have yet VirtulBox installed:

- Download and install VirtulBox
- Import the Appliance (*.OVA) provided on the e-learning.

If you already have the “Labcom” virtual machine installed and you are already using it inside GNS3, in order to proceed with this guide, please configure the networking as explained on the following section.

If you prefer to use multiple VM instances, one for GNS3 and one for this Guide, clone the original machine in VirtualBox interface.

2. Virtual Machine Network preparation

Go to Oracle VM VirtualBox Manager

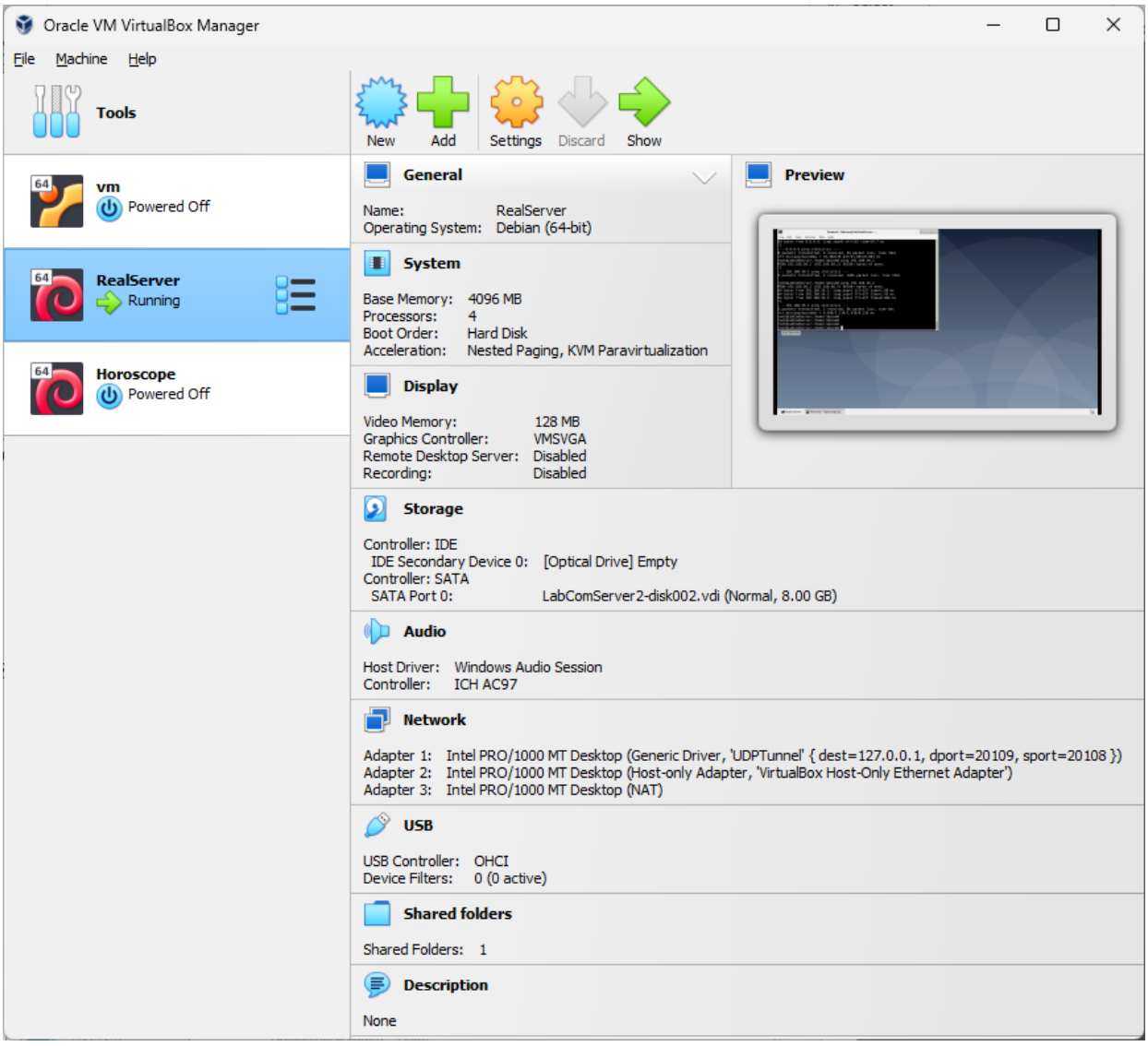


Figure 1: Oracle VirtualBox Manager

Select the correct VM and go to settings.

Edit the network settings to have 3 network adapters, configured as presented on the following pictures.

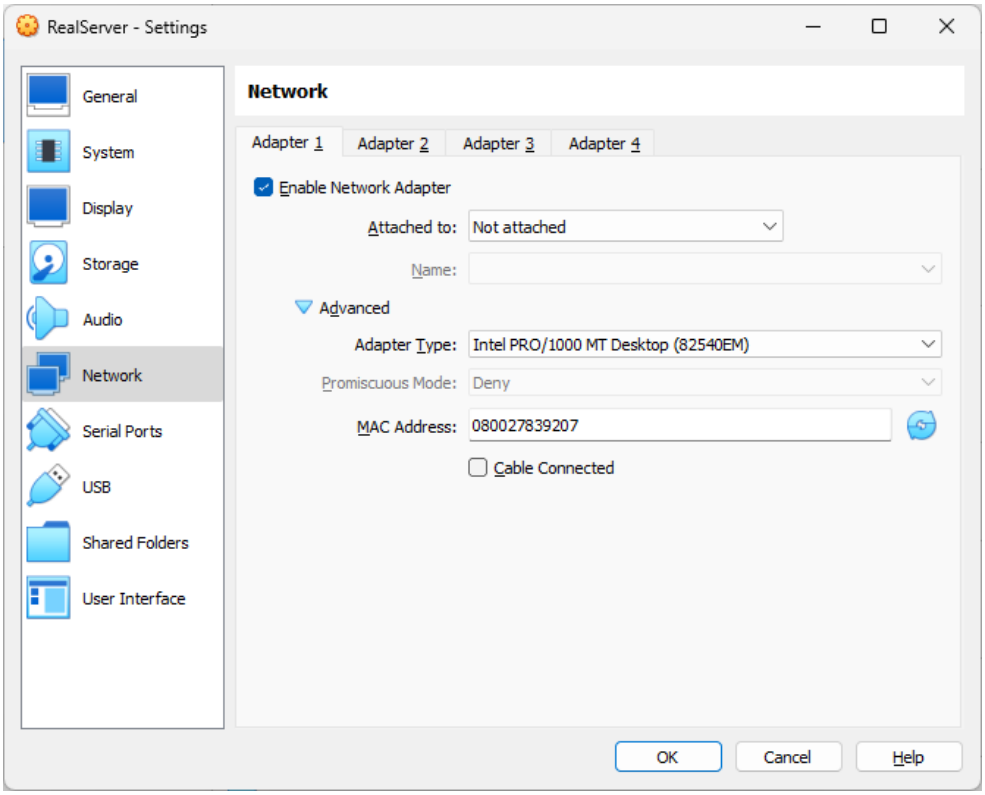


Figure 2: VM Network Adapter 1

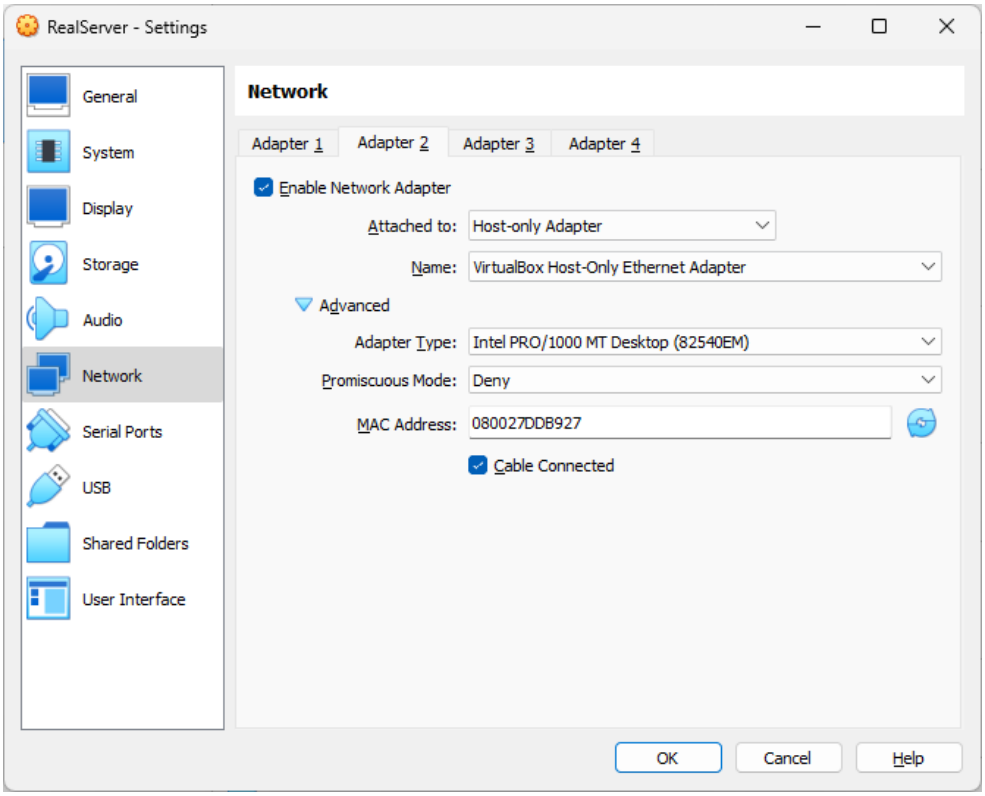


Figure 3: VM Network Adapter 2

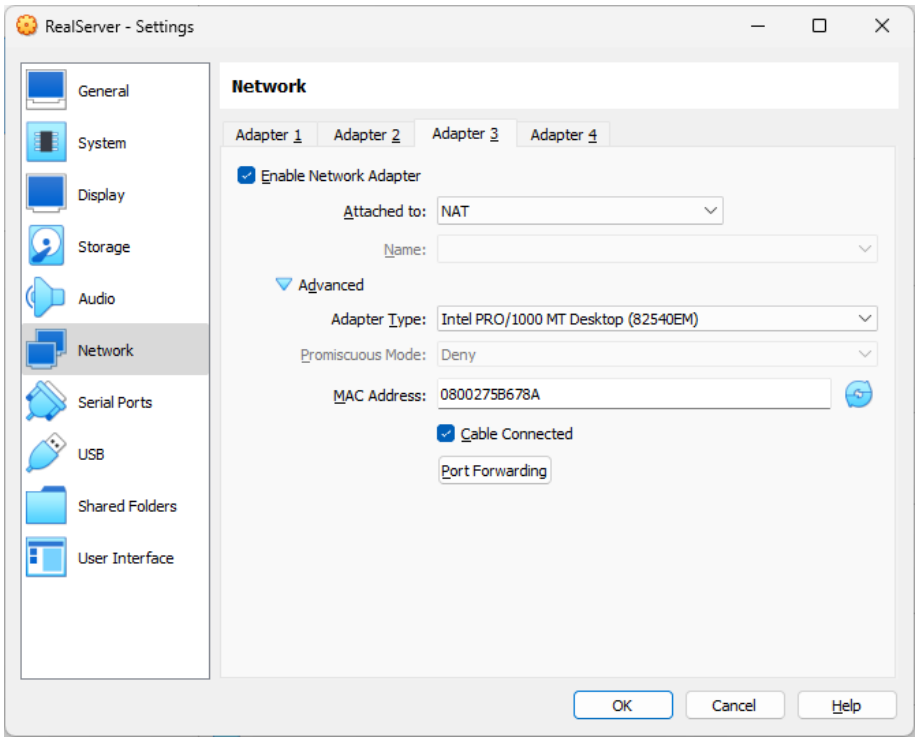


Figure 4: VM Network Adapter 3

At this stage, you may also go to GNS3, without opening any project, and select Edit->Preferences->VirtualBox VMs and edit the configuration of the VM to guarantee that you choose 3 Adapters.

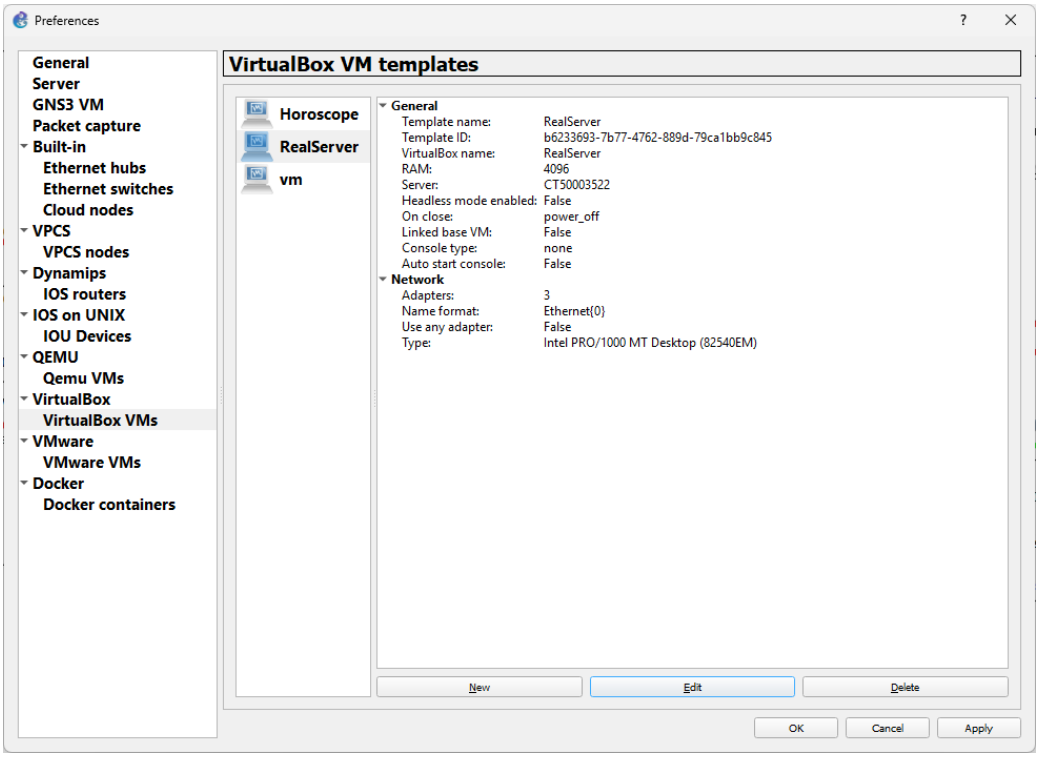


Figure 5: VirtualBox VM templates

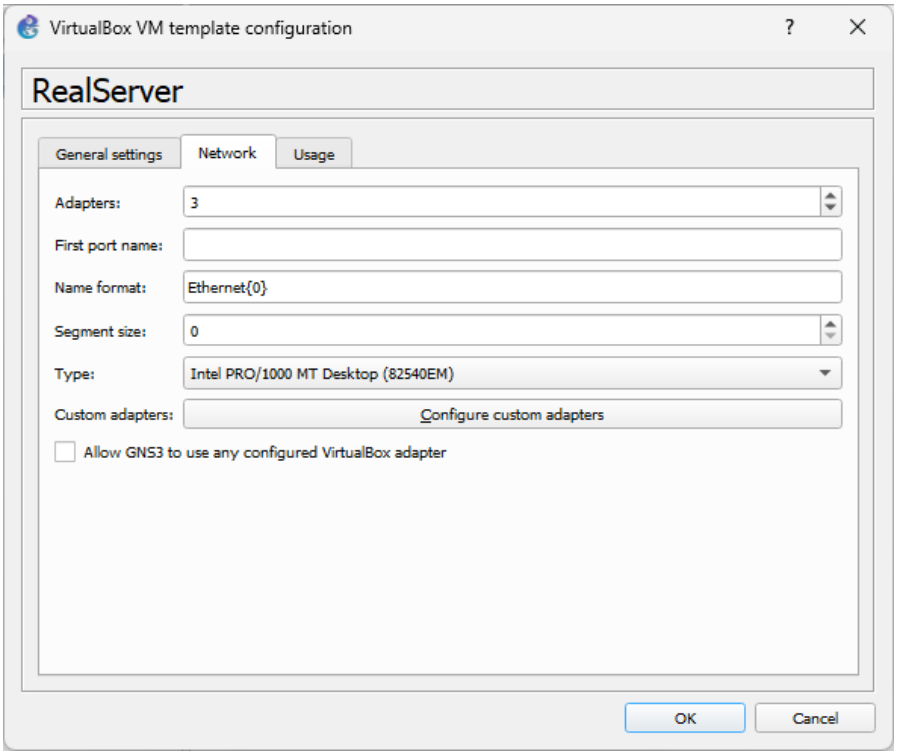
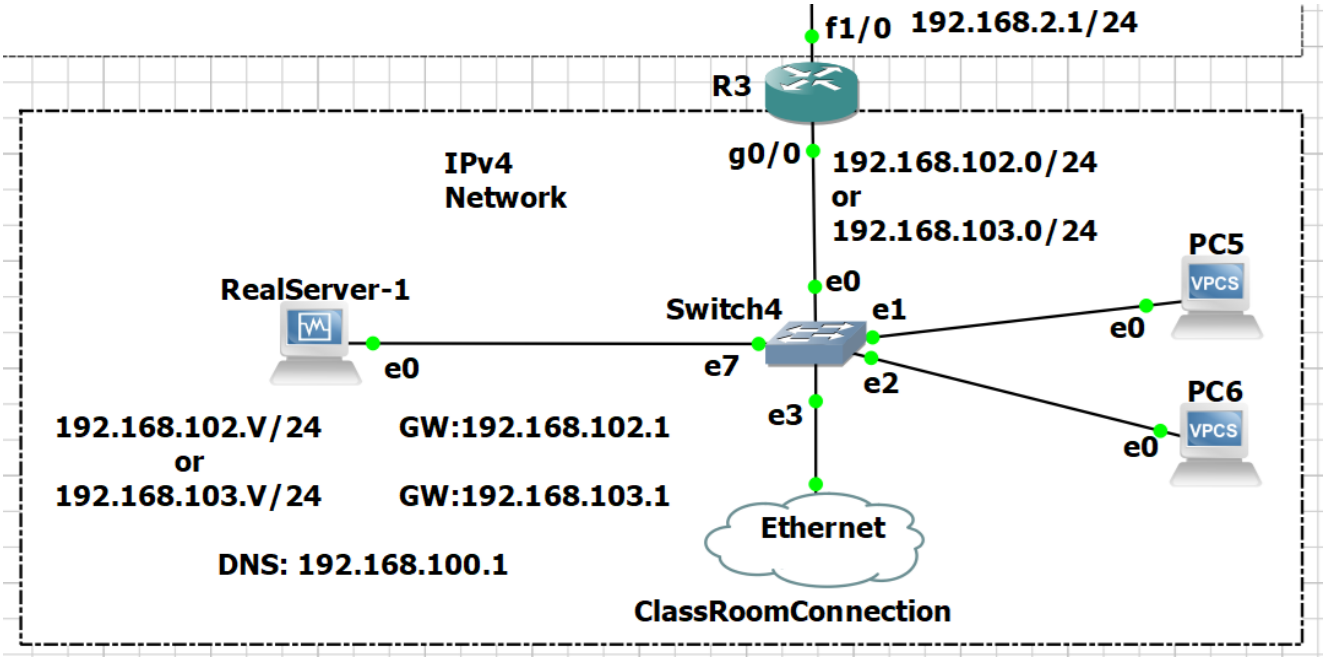


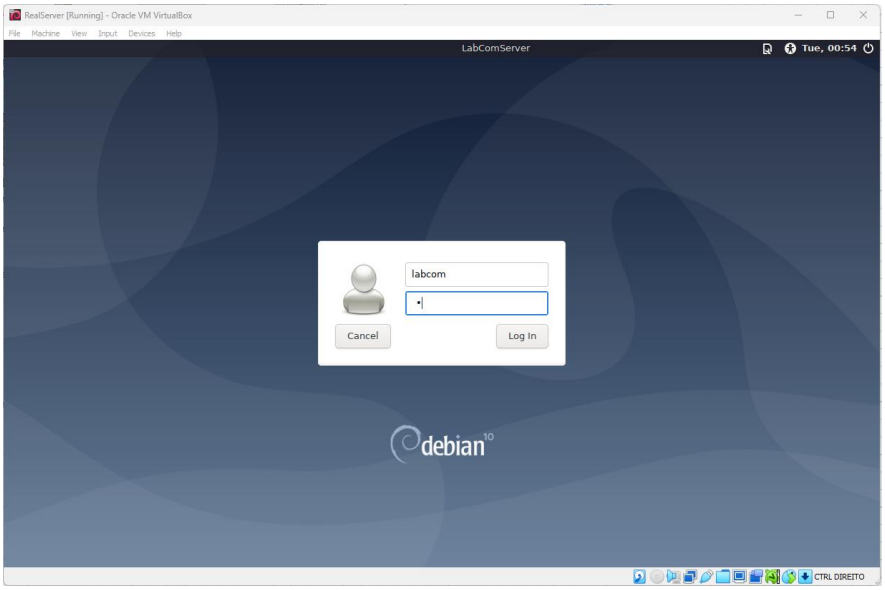
Figure 6: VirtualBox VM Network

3. IPv4 Network Services

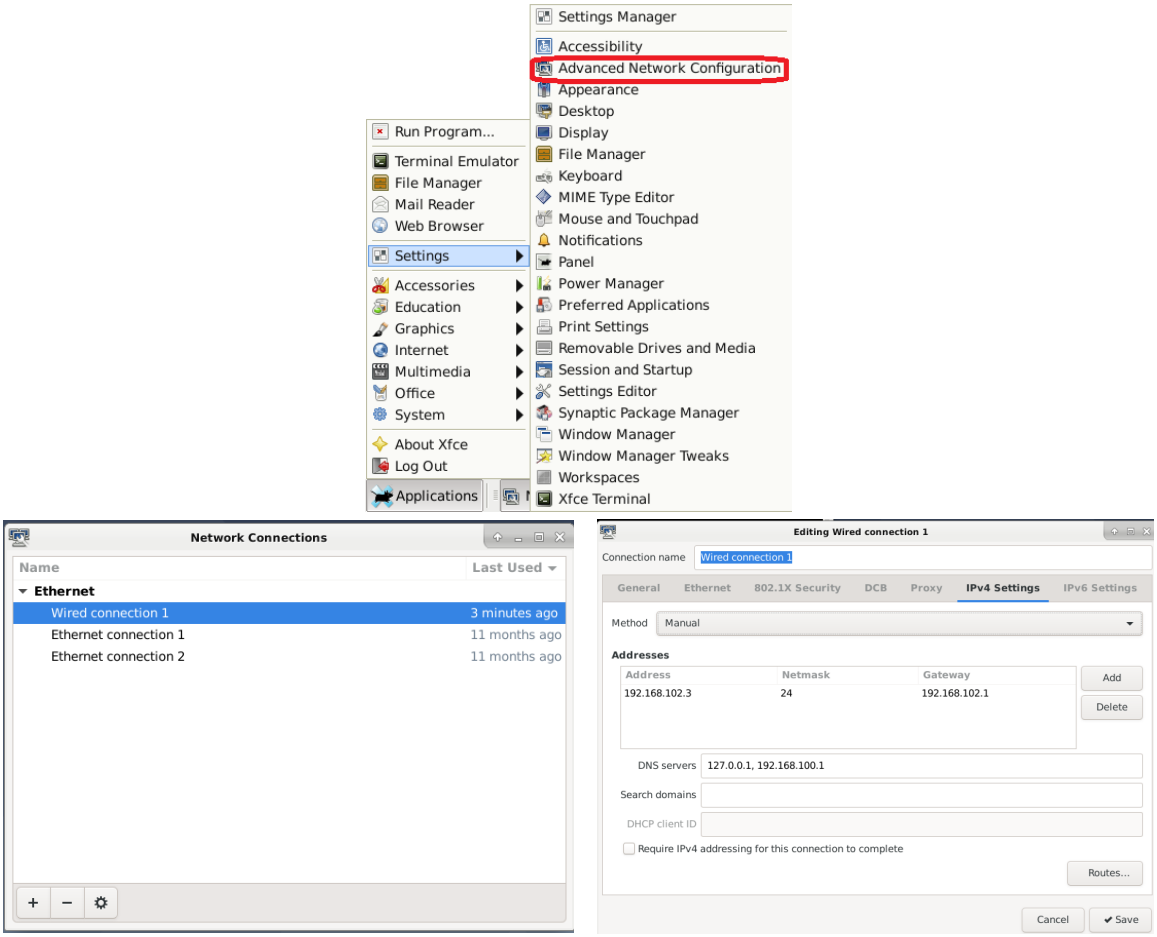
Go to GNS3, to the Class project, and add the VM, attached on e0 to the Switch 4 as shown on the following figure.



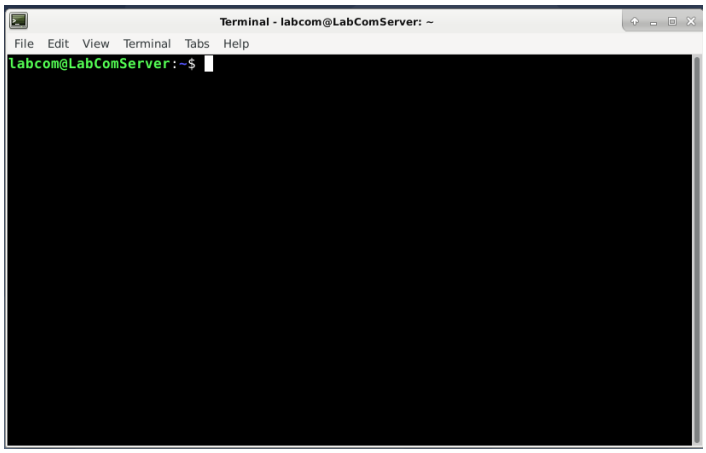
Start the VM inside GNS3 (wait for VirtualBox to start it). After the VM is up and running, login using user/password: labcom/labcom



Next, follow the next instructions in order to configure the network adapter with the IP address (192.168.102/3.V) that you may find in Annex A.



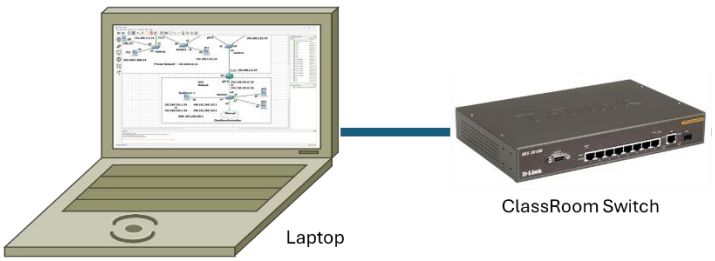
After concluding these steps, open a terminal window on the VM:



Run the command "*sudo ifconfig*" and check the network interfaces.
The relevant network interface should be "enp0s3".
Run the command "*sudo ifconfig enp0s3 down*" and afterwards "*sudo ifconfig enp0s3 up*"

Confirm that the interface is configured with the correct IP address.
Ping R3 g0/0 IPv4 address (192.168.102/3.X) (R3 must be started and with g0/0 configured)

Now connect your project to the classroom network.



From the VM, ping its Gateway (192.168.102.1 or 192.168.103.1). If you do not succeed, try to delete and add again the link between switch 4 and the cloud (if you still do not succeed, ask your teacher for help).

Once connectivity to the Internet is active, it is time to install the software needed for this guide.

- *sudo apt-get update*
- *sudo apt-get install bind9* *// Bind9 DNS Server*
- *sudo apt-get install apache2* *// Apache2 Web Server*

In case of error, please check if /etc/apt/source.list is as follows:

```
root@LabComServer:/home/labcom# cat /etc/apt/sources.list

deb http://mirrors.up.pt/debian/ buster main
deb-src http://mirrors.up.pt/debian/ buster main

deb http://security.debian.org/debian-security buster/updates main
deb-src http://security.debian.org/debian-security buster/updates main

# buster-updates, previously known as 'volatile'
deb http://mirrors.up.pt/debian/ buster-updates main
deb-src http://mirrors.up.pt/debian/ buster-updates main
```

3.1. DNS

7. At the server, verify if the DNS (bind9) service is installed and active with the command:

```
sudo systemctl status bind9
```

To start the FTP service and recheck the status of the service:

```
sudo systemctl start bind9
sudo systemctl stop bind9
```

8. Assuming that you have the domain RC1.pt, configure your DNS server as master with authority over this domain. Start by creating the zone for the domain by adding to the configuration file ***/etc/bind/named.conf.local*** the following definitions:

sudo mousepad /etc/bind/named.conf.local or ***sudo nano /etc/bind/named.conf.local***
or ***sudo vim /etc/bind/named.conf.local***

```
zone "rc1.pt" in{
     type master;                    //define the zone as master
     file "/etc/bind/db.rc1.pt";          //file with the domain records
  };
```

Create the file /etc/bind/db.rc1.pt:
sudo mousepad /etc/bind/db.rc1.pt or ***sudo nano /etc/bind/db.rc1.pt***
or ***sudo vim /etc/bind/db.rc1.pt***

and add to it the following definitions and DNS records:

```
$TTL  604800
$ORIGIN rc1.pt.
@      IN     SOA    ns1.rc1.pt. adm.rc1.pt. (
                     2           ; Serial
                     604800      ; Refresh
                     86400       ; Retry
                     2419200     ; Expire
                     604800)     ; Negative Cache TTL
       IN     NS     ns1.rc1.pt.
ns1    IN     A      192.168.102/3.V
@      IN     A      192.168.102/3.V
www    IN     A      192.168.102/3.V
siteA  IN     A      192.168.102/3.V
R3     IN     A      192.168.102/3.X
StNAT  IN     A      192.168.102/3.W
```

Verify if the file with the zone definitions is correctly constructed:

```
sudo named-checkzone rc1.pt db.rc1.pt
```

Restart the DNS server:

```
systemctl restart bind9
```

At the Host PC, define your Virtual Server as main DNS server, start a Wireshark capture in the interface that connects to the server (Host-only adapter), perform the following DNS queries:

```
nslookup rc1.pt
nslookup www.rc1.pt
nslookup siteA.rc1.pt
nslookup R3.rc1.pt
nslookup StNAT.rc1.pt
```

Note: To configure the DNS server in Linux edit the file /etc/resolv.conf with the Virtual Server address.
>> Analyze the captured DNS packets.

3.2. HTTP

9. At the server, verify if the DNS (apache2) service is installed and active with the command:

```
sudo systemctl status apache2
```

To start the FTP service and recheck the status of the service:

```
sudo systemctl start apache2
sudo systemctl status apache2
```

Analyze the content of the apache2 main configtration file (/etc/apache2/apache2.conf).

sudo cat /etc/apache2/apache2.conf

At the Host PC, start a Wireshark capture in the interface that connects to the server (Host-only adapter), and test the HTTP server accessing the following URL (with a browser):

```
http://192.168.102/3.V
http://rc1.pt
http://www.rc1.pt
http://siteA.rc1.pt
```

>> Based on the captured packets, identify and analyze the TCP sessions (including sequence and acknowledge numbers and flags), and the content of the HTTP packets. Explain how the HTTP server identifies the webpage/data to sent to the client.

10. In the apache2 default content folder /var/www/html/, create a new folder named “rc1.pt-80” (name format is not mandatory, but it is import to maintain consistence, e.g., *domain-port*) to store the webpage associated with the domain rc1.pt.

sudo mkdir /var/www/html/rc1.pt-80

Inside the new folder create a new HTML file named index.html (default webpage name) with the following content (you may change it):

sudo mousepad /var/www/html/rc1.pt-80index.html
or sudo nano /var/www/html/rc1.pt-80index.html
or sudo vim /var/www/html/rc1.pt-80index.html

```
<html>
<body>
<h1>Redes de Comunicações I</h1>
<h1>rc1.pt</h1>
<h2>Porto 80</h2>
</body>
</html>
```

In order to create a new website at the server it is required to define a new apache2 Virtual Host. in the folder /etc/apache2/sites-available/ create a new file (named rc1.pt-80.conf)

sudo mousepad /etc/apache2/sites-available/rc1.pt-80.conf
or sudo nano /etc/apache2/sites-available/rc1.pt-80.conf
or sudo vim /etc/apache2/sites-available/rc1.pt-80.conf

with the following content:

```
<VirtualHost *:80>
      DocumentRoot /var/www/html/rc1.pt-80
      ServerName rc1.pt
</VirtualHost>
```

Enable the new domain/site and restart the HTTP server:

```
sudo a2ensite rc1.pt-80
sudo systemctl restart apache2
```

Test the HTTP server accessing the following URL (with a browser):

http://192.168.102/3.V
http://rc1.pt
http://www.rc1.pt
http://siteA.rc1.pt

>> What do you conclude?

11. At the Virtual Host definition (rc1.pt-80) add the following directive (below *ServerName*):

```
ServerAlias www.rc1.pt
```

Restart the HTTP server:

```
sudo systemctl apache2 restart
```

Test the HTTP server accessing the following URL:

http://192.168.102/3.V
http://rc1.pt
http://www.rc1.pt
http://siteA.rc1.pt

>> What do you conclude?

12. Create a different site/webpage for the subdomain siteA.rc1.pt.

ANNEX A – Virtual Machine IP Address

Mec Num	Name	VirtualMachine (192.168.102/3.V)			
60727	TIAGO JOÃO PEREIRA GOMES	192.168.	102	.	7
72476	MARIA LUISA RODRIGUES DA SILVEIRA LEITE	192.168.	102	.	11
77129	ANDRADE ANTÓNIO FRANCISCO	192.168.	102	.	15
79319	SIMONE RAQUEL NOVO PASCOAL	192.168.	102	.	19
96661	NICOLE MONTEIRO RAKOV	192.168.	102	.	23
97288	RÚBEN JORGE ESPÍRITO SANTO PEREIRA	192.168.	102	.	27
102394	ISABEL MARIA CASACA DA SILVA	192.168.	102	.	31
103583	JUAN SEBASTIAN PEREIRA CARPINTERO	192.168.	102	.	35
107987	GABRIEL ESTÊVÃO SAL MONTEIRO	192.168.	102	.	39
108154	TOMÁS CORREIA DE SÁ DOS SANTOS ALVES	192.168.	102	.	43
110509	RUI PEREIRA DE MELO SILVA DE ALBUQUERQUE	192.168.	102	.	47
112771	GONÇALO MARIA MOREIRA MENDES OLIVEIRA DA MOTA	192.168.	102	.	51
114251	RÚBEN MIGUEL ALMEIDA COELHO	192.168.	102	.	55
114292	DIOGO CAPÃO GRANGEIA	192.168.	102	.	59
114557	GUSTAVO GUEDES GARCIA	192.168.	102	.	59
114982	MARCOS MATOS KOUFALIOTIS	192.168.	102	.	63
115876	GUILHERME DA COSTA GRAÇA	192.168.	102	.	67
115879	JOAO PEDRO RAMOS VITORIA DA SILVA	192.168.	102	.	71
116113	TIAGO RAFAEL CANDEIAS PEDROSA	192.168.	102	.	75
117592	RUBÉM MAMBO GARCIA ANDRÉ	192.168.	102	.	79
118621	MATHEUS CONCEIÇÃO PINTO	192.168.	102	.	83
118643	JOÃO ANTÓNIO HENRIQUES VIEIRA	192.168.	102	.	87
118648	GUILHERME ALVES ESCÓRCIO	192.168.	102	.	91
118683	TIAGO PEREIRA CARVALHO DOS SANTOS PREGUIÇA	192.168.	102	.	95
118781	PEDRO MIGUEL DA SILVA CORADO	192.168.	102	.	99
118799	DANIEL BOIAN ZAMURCA	192.168.	102	.	103
119012	HUGO AFONSO DE TAVARES LOPES	192.168.	102	.	107
119187	MIGUEL CASTANHEIRA FERNANDES	192.168.	102	.	111
119241	ANDRÉ DIAS CORREIA	192.168.	102	.	115
119527	RODRIGO CONROY NUNES	192.168.	102	.	119
119583	ALEXANDRE OLIVEIRA SILVA	192.168.	102	.	123
119649	MIGUEL MAGALHAES SANTOS	192.168.	102	.	127
119744	NICOLAS BOTELHO DE SOUSA	192.168.	102	.	131
119832	VASCO PEIXOTO ARAÚJO	192.168.	102	.	135
119844	JOANA CASTRO E SILVA	192.168.	102	.	139
119859	JOÃO PEREIRA LEITE	192.168.	102	.	143
119871	ALEXANDRE RAFAEL DE ALMEIDA PEREIRA	192.168.	102	.	147
119928	MADALENA MESQUITA CEREJEIRA AMARO DIOGO	192.168.	102	.	151
120009	JOSÉ RAFAEL MATEUS COELHO	192.168.	102	.	155
120120	LUCAS PIRES ROCHINHA	192.168.	102	.	159
120124	PEDRO FRANCISCO DIAS TAVARES	192.168.	102	.	163
120172	JOÃO PEDRO DIAS DA SILVA	192.168.	102	.	167

Mec Num	Name	VirtualMachine (192.168.102/3.V)			
120173	JOÃO MIGUEL TAVARES MARQUES	192.168.	102	.	171
120284	JOÃO DIOGO DA SILVA CORREIA TEIXEIRA MARTINS	192.168.	102	.	175
120300	ÂNGELO MANUEL CAUCHIE FIGUEIREDO	192.168.	102	.	179
120353	VIACHESLAV SEREDA	192.168.	102	.	183
120383	PEDRO NUNO DE PINA BARBEDO MONTEIRO	192.168.	102	.	187
120393	EDUARDO MORENO	192.168.	102	.	191
120958	GONÇALO AZEVEDO MOREIRA	192.168.	102	.	195
121728	JOÃO MOISÉS KUTAYA	192.168.	102	.	199
122892	LAURA MORAES TAKIGAMI GARCIA	192.168.	102	.	203
122895	JOSUÉ KAHUÃ GOMES DOS SANTOS	192.168.	102	.	207
123430	SANJAY THARU	192.168.	102	.	211
123433	FERNANDA ISABEL DO NASCIMENTO FLORIANO	192.168.	102	.	215
124686	RODRIGO MIGUEL CRUZ ANDRADE	192.168.	102	.	219
124693	DAVIDE DOS SANTOS SILVA	192.168.	102	.	223
124750	RODRIGO EDUARDO NEVES GONÇALVES	192.168.	102	.	227
124765	ANDRÉ HILÁRIO BRAZ	192.168.	102	.	231
124779	DANIEL FERREIRA CARVALHO	192.168.	102	.	235
124788	ANTÓNIO BERNARDO NUNES DE LIMA	192.168.	102	.	239
124823	LEONARDO GOMES DA SILVA	192.168.	102	.	243
124896	ANDRÉ FILIPE VIEIRA BRANDÃO	192.168.	102	.	247
124917	DUARTE ALMEIDA PEREIRA COELHO	192.168.	102	.	251
124921	NELSON ROCHA RAMOS	192.168.	102	.	3
124926	SANTIAGO RODRIGUES DOS SANTOS	192.168.	103	.	7
124972	SAMUEL LUCAS ROCHA RAMOS	192.168.	103	.	11
125016	LUIS CARLOS DE CASTRO OLIVEIRA	192.168.	103	.	15
125039	GUILHERME COIMBRA ANTUNES	192.168.	103	.	19
125050	TOMAS CARDOSO E PINTO	192.168.	103	.	23
125087	HENRIQUE PAESE TARDELLI	192.168.	103	.	27
125122	MARTIM BATISTA LEITNER	192.168.	103	.	31
125160	VICENTE AMORIM SILVA	192.168.	103	.	35
125171	RODRIGO MIGUEL CASTRO E SILVA	192.168.	103	.	39
125193	BRUNO FILIPE OLIVEIRA GONÇALVES	192.168.	103	.	43
125214	FRANCISCO RICARDO SALAZAR E SILVA	192.168.	103	.	47
125270	PEDRO JORGE LOPES RAMOS	192.168.	103	.	51
125293	RICARDO FRANCISCO ASSEMBLEIA FRANCISCO	192.168.	103	.	55
125302	JOÃO MANUEL SOARES PEREIRA	192.168.	103	.	59
125305	ANA MARGARIDA DUARTE REIS	192.168.	103	.	63
125413	LARA RODRIGUES MARQUES	192.168.	103	.	67
125442	AFONSO ALMEIDA CRUZ	192.168.	103	.	71
125518	GONÇALO DE PINHO SOUSA	192.168.	103	.	75
125527	GUILHERME TAVARES OLIVEIRA	192.168.	103	.	79
125549	JOÃO SINARÉ TORRES DE OLIVEIRA	192.168.	103	.	83
125636	GUILHERME VIVEIROS COSTA	192.168.	103	.	87
125718	FÁBIO EMANUEL MOREIRA RENDA	192.168.	103	.	91

Mec Num	Name	VirtualMachine (192.168.102/3.V)			
125738	INES VEIGAS CARDOSO	192.168.	103	.	95
125761	AFONSO PINTO CORREIA COELHO	192.168.	103	.	99
125804	DINIS FILIPE DA SILVA NÉRI MARQUES CARVALHO	192.168.	103	.	103
125828	LOURENÇO GOMES SECO	192.168.	103	.	107
125836	PEDRO MIGUEL ALMEIDA BELEZA	192.168.	103	.	111
125855	JOÃO GABRIEL DA SILVA ROCHA	192.168.	103	.	115
125982	LUCAS GASPAR MARQUES	192.168.	103	.	119
125986	EDUARDO CONSTANTINO VAZ ALVES	192.168.	103	.	123
125996	TIAGO FILIPE ALMEIDA TRUTA	192.168.	103	.	127
126008	FILIPE SEQUEIRA CARDOSO GOMES	192.168.	103	.	131
126011	MARGARIDA DA SILVA TEIXEIRA	192.168.	103	.	135
126033	GUSTAVO NOVAIS RODRIGUES	192.168.	103	.	139
126036	DINIS PEDRO MONTEIRO	192.168.	103	.	143
126124	RODRIGO BARBOSA FIGUEIREDO	192.168.	103	.	147
126132	MARTIM JESUS PEREIRA DE ALMEIDA	192.168.	103	.	151
126154	MARCO ANTÓNIO CRUZ FLOR	192.168.	103	.	155
126164	FELIPE DE OLIVEIRA SILVA ROCHA	192.168.	103	.	159
126180	GABRIEL EDUARDO DE JÉSUS TARACHE GUZMÁN	192.168.	103	.	163
126193	EDGAR SIMÃO NOVO PASCOAL	192.168.	103	.	167
126209	LUÍS RODRIGO DA SILVA LOPES	192.168.	103	.	171
126252	RODRIGO CARREIRA DA SILVA	192.168.	103	.	175
126253	PEDRO SANTOS TAVARES	192.168.	103	.	179
126265	SAMUEL JOSÉ MÓNICA CARVALHAIS	192.168.	103	.	183
126290	ELIANA HUANG	192.168.	103	.	187
126392	DIOGO PAIVA VEIGA	192.168.	103	.	191
126418	CÉSAR GONÇALVES CARVALHO	192.168.	103	.	195
126421	MANUEL AGUIAR CAMPOS CARDOSO DA SILVA	192.168.	103	.	199
126426	GONÇALO COSTA SILVA	192.168.	103	.	203
126460	GABRIEL MARQUES CANHÃO	192.168.	103	.	207
126480	JOÃO MARIA FIGUEIREDO RIBEIRO	192.168.	103	.	211
126489	JOANA CATARINA NOGUEIRA GIÃO	192.168.	103	.	215
126541	JÉSSICA ZHENG	192.168.	103	.	219
127378	AFONSO MIGUEL LOUREIRO MELO	192.168.	103	.	223
127419	MIGUEL BATISTA LOPES	192.168.	103	.	227
127548	GONÇALO MEDEIROS MOURA	192.168.	103	.	231
129512	JORGE MANUEL MORAIS	192.168.	103	.	235
130382	VÍCTOR GIL SANZ	192.168.	103	.	239