

Projeto Final, Fundamentos de Redes de Comunicação

**CURSO TÉCNICO SUPERIOR PROFISSIONAL EM
REDES E SISTEMAS INFORMÁTICOS**

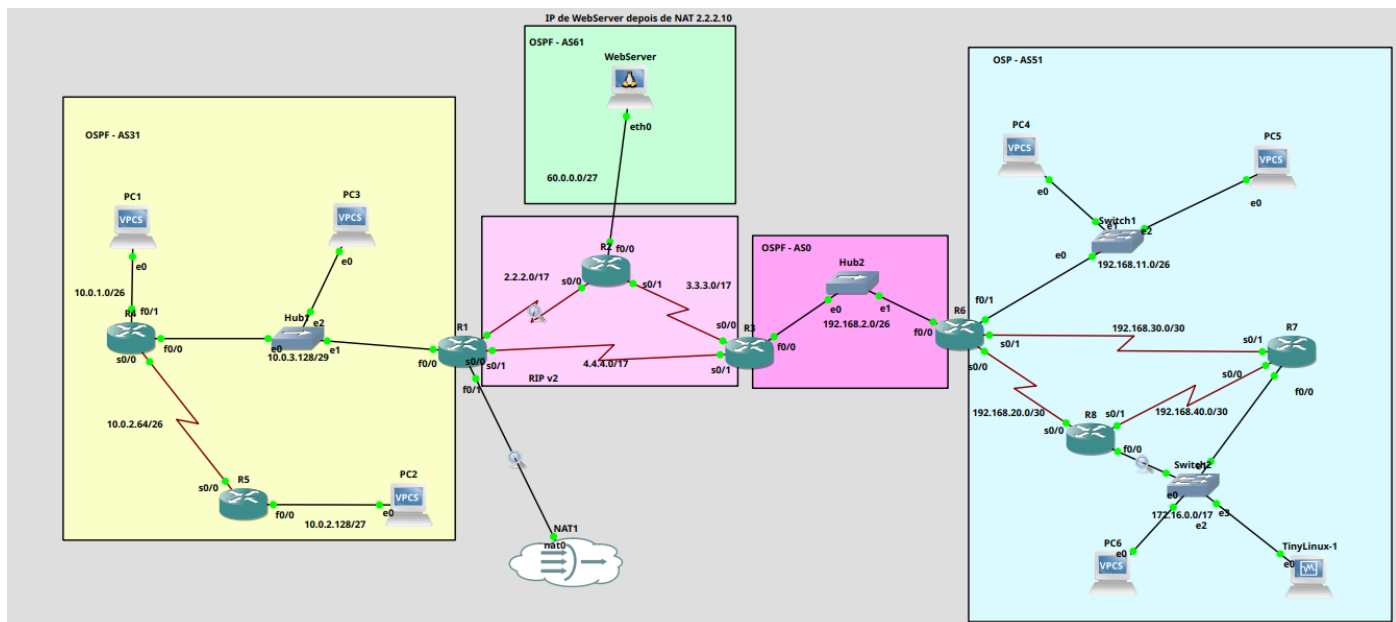
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Link Google Drive com o projeto:

<https://drive.google.com/file/d/1QNuci69K3woc42b269zMHExWZyJ2pXyB/view?usp=sharing>

1. Execução do Trabalho

1.1) Topologia da Rede, com as áreas OSPF correspondentes ao nosso grupo (X = 3 - 2):



c) Configuração OSPF e RIP nos Routers envolvidos, de modo às redes OSPF divulgarem a informação da rede central, que possui protocolo RIP(v2); e, ao mesmo tempo, permitir que a parte configurada em RIP(v2) partilha e propaga a informação recebida pelo protocolo OSPF:

Router 1:

```
R1#conf t
Enter configuration commands, one per line. End with CNTL/Z.
R1(config)#router ospf 1
R1(config-router)#redistribute rip subnets
R1(config-router)#
```

```
R1(config)#router rip
R1(config-router)#redistri
R1(config-router)#redistribute ospf 1 metric 1
R1(config-router)#end
```

Router 3:

```
R3#conf t
Enter configuration commands, one per line. End with CNTL/Z.
R3(config)#router ospf 1
R3(config-router)#redistribute rip subnets
R3(config-router)#end
R3#write
*Mar  1 00:52:25.211: %SYS-5-CONFIG_I: Configured from console by con
R3#write
```

```
R3#conf t
Enter configuration commands, one per line. End with CNTL/Z.
R3(config)#router rip
R3(config-router)#redis
R3(config-router)#redistribute ospf 1 metric 1
R3(config-router)#end
R3#write
*Mar  1 01:02:34.543: %SYS-5-CONFIG_I: Configured from console by console
R3#write
```

d) Configuração do Router R2 para fazer NAT para o servidor interno:

De modo à rede ficar protegida, configurámos NAT estático da seguinte forma:

```
R2#conf t
Enter configuration commands, one per line. End with CNTL/Z.
R2(config)#ip nat inside source static 60.0.0.1 2.2.2.10
R2(config)#router rip
R2(config-router)#version 2
R2(config-router)#network 2.2.2.10
```

Para avisar os outros routers que R2 tem como IP Inside Global 2.2.2.10, usámos o RIPv2.

Não é possível fazer ping para 60.0.0.1, apesar de ser esse o IP real do WebServer. Mas, fazendo ping a 2.2.2.10, é possível chegar ao WebServer, ficando assim a rede protegida, através do NAT.

```

R2#show ip nat statistics
Total active translations: 1 (1 static, 0 dynamic; 0 extended)
Outside interfaces:
  Serial0/0, Serial0/1
Inside interfaces:
  FastEthernet0/0
Hits: 87  Misses: 0
CEF Translated packets: 87, CEF Punted packets: 0
Expired translations: 12
Dynamic mappings:
  Appl doors: 0
  Normal doors: 0
  Queued Packets: 0

```

```

R2#show ip nat translations
Pro Inside global      Inside local      Outside local      Outside global
--- 2.2.2.10           60.0.0.1          ---                ---

```

e) No enunciado não referia o tipo de WIC 0 a usar, pelo que optámos por WIC-2T

IOS router templates

- c2691
- c3600
- c3725
- c3745
- EtherSwitch router 3620
- EtherSwitch router 3725
- EtherSwitch router 3745

General

Template name: c2691
 Template ID: 18eb3a3b-e401-4e8f-82ae-9cc12fde919b
 Default name format: R{0}
 Server: labi-VirtualBox
 Platform: c2691
 Image: /home/labi/GNS3/images/IOS/c2691-adventerprisek9
 Console type: telnet
 Auto start console: False
 Idle-PC: 0x60bcf9f8
 Startup-config: ios_base_startup-config.txt

Memories and disks

RAM: 192 MiB
 NVRAM: 256 KiB
 I/O memory: 5%
 PCMCIA disk0: 0 MiB
 PCMCIA disk1: 0 MiB
 Auto delete: True

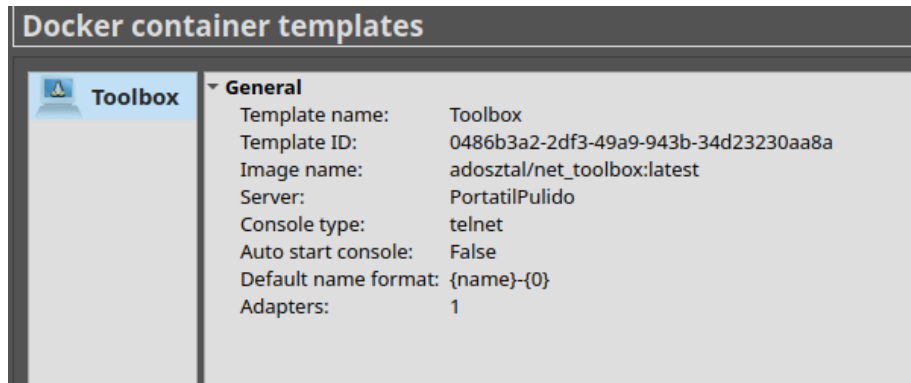
Adapters

Slot 0: GT96100-FE
 Slot 1: NM-16ESW

WICs

WIC 0: WIC-2T

f) GNS3 Toolbox appliance:



g)

Configurações NAT no Router 1 / Configuração da Cloud NAT:

```
R1#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
R1(config)#ip ad
R1(config)#ip add
R1(config)#int f0/1
R1(config-if)#ip add
R1(config-if)#ip address dhcp
R1(config-if)#no shut
R1(config-if)#no shutdown
```

```
R1(config)#int f0/1
R1(config-if)#ip nat out
R1(config-if)#ip nat outside
R1(config-if)#
*Mar  1 00:05:33.531: %LINEPROTO-5-UPDOWN
o up
R1(config-if)#exit
R1(config)#int f0/0
R1(config-if)#ip nat inse
R1(config-if)#ip nat ins
R1(config-if)#ip nat inside
R1(config-if)#exit
R1(config)#int s0/0
R1(config-if)#ip nat inside
R1(config-if)#exit
R1(config)#int s0/1
R1(config-if)#ip nat inside
R1(config-if)#exit
```

```
R1#show run | inc nat
ip nat inside
ip nat inside
ip nat outside
ip nat inside
ip nat inside source list 1 interface FastEthernet0/1 overload
```

O comando 'ip nat inside source list 1 interface FastEthernet0/1 overload' permite que os pacotes que vão para o exterior, tenham como IP de origem o IP da interface f0/1 do Router R1.

```
R1#show access-list
Standard IP access list 1
 10 permit 10.0.0.0, wildcard bits 0.255.255.255 (910 matches)
 20 permit 192.168.0.0, wildcard bits 0.0.255.255 (7 matches)
 30 permit 172.16.0.0, wildcard bits 0.0.255.255 (233 matches)
R1#
```

Encontrámos problemas ao usar 'permit any' na access list. Em vez disso, autorizámos as todas as nossas redes privadas, o que resolveu o esse problema.

Comprovativo de que o Router R1 faz NAT para a internet:

```
tc@box:~$
tc@box:~$
tc@box:~$
tc@box:~$
tc@box:~$ ping 8.8.8.8
PING 8.8.8.8 (8.8.8.8): 56 data bytes
64 bytes from 8.8.8.8: seq=1 ttl=113 time=45.280 ms
64 bytes from 8.8.8.8: seq=2 ttl=113 time=46.614 ms
64 bytes from 8.8.8.8: seq=3 ttl=113 time=48.271 ms
64 bytes from 8.8.8.8: seq=4 ttl=113 time=40.436 ms
64 bytes from 8.8.8.8: seq=5 ttl=113 time=42.867 ms
^C
--- 8.8.8.8 ping statistics ---
6 packets transmitted, 5 packets received, 16% packet loss
round-trip min/avg/max = 40.436/44.693/48.271 ms
```

Comprovativo de que o IP é alterado ao sair da rede privada do Router R1:

```

0100 .... = Version: 4
.... 0101 = Header Length: 20 bytes (5)
▸ Differentiated Services Field: 0x00 (DSCP: CS0, ECN: Not-ECT)
Total Length: 84
Identification: 0xd479 (54393)
▸ 010. .... = Flags: 0x2, Don't fragment
...0 0000 0000 0000 = Fragment Offset: 0
Time to Live: 60
Protocol: ICMP (1)
Header Checksum: 0x9f3e [validation disabled]
[Header checksum status: Unverified]
Source Address: 192.168.250.56
Destination Address: 8.8.8.8

```

2. Identificação das redes usadas e configuradas

Rede	ID Rede	Nº de hosts	Máscara	1º IP	Último IP	IP Broadcast
1	10.0.1.0	62	255.255.255.192	10.0.1.1	10.0.1.62	10.0.1.63
2	10.0.2.64	62	255.255.255.192	10.0.2.65	10.0.2.126	10.0.2.127
3	10.0.2.128	30	255.255.255.224	10.0.2.129	10.0.2.158	10.0.2.159
4	10.0.3.128	6	255.255.255.248	10.0.3.129	10.0.3.134	10.0.3.135
5	2.2.2.0	32766	255.255.128.0	2.2.2.1	2.2.127.254	2.2.127.255
6	3.3.3.0	32766	255.255.128.0	3.3.3.1	3.3.127.254	3.3.127.255
7	4.4.4.0	32766	255.255.128.0	4.4.4.1	4.4.127.254	4.4.127.255
8	60.0.0.0	30	255.255.255.224	60.0.0.1	60.0.0.30	60.0.0.31
9	192.168.2.0	62	255.255.255.192	192.168.2.1	192.168.2.62	192.168.2.63
10	192.168.11.0	62	255.255.255.192	192.168.11.1	192.168.11.62	192.168.11.63
11	192.168.20.0	2	255.255.255.252	192.168.20.1	192.168.20.2	192.168.20.3
12	192.168.30.0	2	255.255.255.252	192.168.30.1	192.168.30.2	192.168.30.3
13	192.168.40.0	2	255.255.255.252	192.168.40.1	192.168.40.2	192.168.40.3
14	172.16.0.0	32766	255.255.128.0	172.16.0.1	172.16.127.254	172.16.127.255

3. Identificação dos Equipamentos

Equipamento	Interface	IP	Máscara	Gateway	MAC addresses
Router 1	f0/0	10.0.3.134	255.255.255.248		C0:01:21:66:00:00
	f0/1	DHCP	DCHP		C0:01:21:66:00:01
	s0/0	2.2.127.254	255.255.128.0		
	s0/1	4.4.127.254	255.255.128.0		
Router 2	f0/0	60.0.0.30	255.255.255.224		C0:02:21:A4:00:00
	s0/0	2.2.2.1	255.255.128.0		
	s0/1	3.3.3.1	255.255.128.0		
Router 3	f0/0	192.168.2.62	255.255.255.192		C0:03:21:D3:00:00
	s0/0	3.3.3.2	255.255.128.0		
	s0/1	4.4.4.1	255.255.128.0		
Router 4	f0/0	10.0.3.129	255.255.255.248		C0:04:21:EF:00:00
	f0/1	10.0.1.62	255.255.255.192		C0:04:21:EF:00:01
	s0/0	10.0.2.126	255.255.255.192		
Router 5	f0/0	10.0.2.158	255.255.255.224		C0:05:22:11:00:00
	s0/0	10.0.2.65	255.255.255.192		
Router 6	f0/0	192.168.2.1	255.255.255.192		C0:06:22:D1:00:00
	f0/1	192.168.11.62	255.255.255.192		C0:06:22:D1:00:01
	s0/0	192.168.20.2	255.255.255.252		
	s0/1	192.168.30.2	255.255.255.252		
Router 7	f0/0	172.16.0.1	255.255.128.0		C0:07:1B:20:00:00
	s0/0	192.168.40.1	255.255.255.252		
	s0/1	192.168.30.1	255.255.255.252		
Router 8	f0/0	172.16.127.254	255.255.128.0		C0:08:1B:40:00:00
	s0/0	192.168.20.1	255.255.255.252		
	s0/1	192.168.40.2	255.255.255.252		
PC1	e0	10.0.1.1	255.255.255.192	10.0.1.62	00:50:79:66:68:00
PC2	e0	10.0.2.129	255.255.255.224	10.0.2.158	00:50:79:66:68:01
PC3	e0	10.0.3.130	255.255.255.248	10.0.3.134	00:50:79:66:68:02
PC4	e0	192.168.11.1	255.255.255.192	192.168.11.62	00:50:79:66:68:03
PC5	e0	168.192.11.2	255.255.255.192	192.168.11.62	00:50:79:66:68:04
PC6	e0	172.16.0.2	255.255.128.0	172.16.127.254	00:50:79:66:68:05
TinyLinux	e0	172.16.0.3	255.255.128.0	172.16.127.254	08:00:27:EF:C9:26
WebServer	e0	60.0.0.1	255.255.255.224	60.0.0.30	02:42:A0:E5:61:00

Configuração dos equipamentos, com mais detalhe:

- Configuração Routers

Router 1:

```
R1#show ip int br
Interface          IP-Address      OK? Method Status      Protocol
FastEthernet0/0    10.0.3.134      YES manual  up          up
Serial0/0          2.2.127.254     YES manual  up          down
FastEthernet0/1    unassigned      YES unset   administratively down  down
Serial0/1          4.4.127.254     YES manual  up          down
FastEthernet1/0    unassigned      YES unset   up          down
FastEthernet1/1    unassigned      YES unset   up          down
FastEthernet1/2    unassigned      YES unset   up          down
FastEthernet1/3    unassigned      YES unset   up          down
FastEthernet1/4    unassigned      YES unset   up          down
FastEthernet1/5    unassigned      YES unset   up          down
FastEthernet1/6    unassigned      YES unset   up          down
```



```

R1 — Konsole

New Tab Split View

interface Vlan1
  no ip address
!
router ospf 1
  log-adjacency-changes
  network 10.0.3.128 0.0.0.7 area 31
!
router rip
  version 2
  network 2.0.0.0
  network 4.0.0.0
  network 10.0.0.0
  no auto-summary

R1#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
R1(config)#ip route 0.0.0.0 0.0.0.0 f0/1
R1(config)#end

```

Router 2:

```
R2#show ip int br
```

Interface	IP-Address	OK?	Method	Status	Protocol
FastEthernet0/0	60.0.0.30	YES	manual	up	up
Serial0/0	2.2.2.1	YES	manual	up	up
FastEthernet0/1	unassigned	YES	unset	administratively down	down
Serial0/1	3.3.3.1	YES	manual	up	down
FastEthernet1/0	unassigned	YES	unset	up	down
FastEthernet1/1	unassigned	YES	unset	up	down
FastEthernet1/2	unassigned	YES	unset	up	down
FastEthernet1/3	unassigned	YES	unset	up	down
FastEthernet1/4	unassigned	YES	unset	up	down
FastEthernet1/5	unassigned	YES	unset	up	down
FastEthernet1/6	unassigned	YES	unset	up	down

```

R2 — Konsole

New Tab Split View

no ip address
!
router ospf 1
  log-adjacency-changes
  network 60.0.0.0 0.0.0.31 area 61
!
router rip
  version 2
  network 2.0.0.0
  network 3.0.0.0
  network 60.0.0.0
  no auto-summary

```

Size: 91 x 15

```
R2#conf t
Enter configuration commands, one per line. End with CNTL/Z.
R2(config)#ip route 0.0.0.0 0.0.0.0 2.2.127.254
R2(config)#end
```

Router 3:

```
R3#show ip int br
```

Interface	IP-Address	OK?	Method	Status	Protocol
FastEthernet0/0	192.168.2.62	YES	manual	up	up
Serial0/0	3.3.3.2	YES	NVRAM	up	up
FastEthernet0/1	unassigned	YES	NVRAM	administratively down	down
Serial0/1	4.4.4.1	YES	NVRAM	up	up

```
!
router ospf 1
 log-adjacency-changes
 network 192.168.2.0 0.0.0.63 area 0
!
router rip
 version 2
 network 3.0.0.0
 network 4.0.0.0
 network 192.168.2.0
 no auto-summary
!
```

```
R3(config)#ip route 0.0.0.0 0.0.0.0 4.4.127.254
R3(config)#end
R3#write
```

Router 4:

```
R4#
*Mar  1 00:32:42.175: %LINEPROTO-5-UPDOWN: Line protocol on Interface Serial0/0, changed state to up
R4#show ip int br
```

Interface	IP-Address	OK?	Method	Status	Protocol
FastEthernet0/0	10.0.3.129	YES	manual	up	up
Serial0/0	10.0.2.126	YES	manual	up	up
FastEthernet0/1	10.0.1.62	YES	manual	up	up
Serial0/1	unassigned	YES	unset	administratively down	down
FastEthernet1/0	unassigned	YES	unset	up	down
FastEthernet1/1	unassigned	YES	unset	up	down
FastEthernet1/2	unassigned	YES	unset	up	down
FastEthernet1/3	unassigned	YES	unset	up	down
FastEthernet1/4	unassigned	YES	unset	up	down
FastEthernet1/5	unassigned	YES	unset	up	down
FastEthernet1/6	unassigned	YES	unset	up	down

```

R4(config)#router ospf 1
R4(config-router)#network 10.0.2.64 0.0.0.63 area 31
R4(config-router)#network 10.0.2.64 0.0.0.63 area 31
*Mar  1 00:06:10.063: %OSPF-5-ADJCHG: Process 1, Nbr 10.0.2.
e
R4(config-router)#network 10.0.3.128 0.0.0.7 area 31
R4(config-router)#network 10.0.1.0 0.0.0.63 area 31
R4(config-router)#end

```

```

R4#conf t
Enter configuration commands, one per line.  End with CNTL/Z
R4(config)#ip route 0.0.0.0 0.0.0.0 10.0.3.134
R4(config)#

```

Router 5:

```

R5#show ip int br

```

Interface	IP-Address	OK?	Method	Status	Protocol
FastEthernet0/0	10.0.2.158	YES	manual	up	up
Serial0/0	10.0.2.65	YES	manual	up	up
FastEthernet0/1	unassigned	YES	unset	administratively down	down
Serial0/1	unassigned	YES	unset	administratively down	down
FastEthernet1/0	unassigned	YES	unset	up	down
FastEthernet1/1	unassigned	YES	unset	up	down

```

Enter configuration commands, one per line.  End with CNTL/Z.
R5(config)#router ospf 1
R5(config-router)#network 10.0.2.128 0.0.0.31 area 31
R5(config-router)#network 10.0.2.64 0.0.0.63 area 31

```

```

R5(config)#ip route 0.0.0.0 0.0.0.0 10.0.2.126
R5(config)#end

```

Router 6:

```

R6#show ip int br

```

Interface	IP-Address	OK?	Method	Status	Protocol
FastEthernet0/0	192.168.2.1	YES	manual	up	up
Serial0/0	192.168.20.2	YES	manual	up	up
FastEthernet0/1	192.168.11.62	YES	manual	up	up
Serial0/1	192.168.30.2	YES	manual	up	up
FastEthernet1/0	unassigned	YES	unset	up	down
FastEthernet1/1	unassigned	YES	unset	up	down
FastEthernet1/2	unassigned	YES	unset	up	down

```

R6#conf t
Enter configuration commands, one per line. End with CNTL/Z.
R6(config)#router ospf 1
R6(config-router)#network 192.168.20.0 0.0.0.3 area 51
R6(config-router)#network 192.168.20.0 0.0.0.3 area 51
*Mar  1 00:13:27.215: %OSPF-5-ADJCHG: Process 1, Nbr 192.168.40.2 on Serial0/0 from LOADING t
o FULL, Loading Done
R6(config-router)#network 192.168.30.0 0.0.0.3 area 51
R6(config-router)#
*Mar  1 00:13:37.595: %OSPF-5-ADJCHG: Process 1, Nbr 192.168.40.1 on Serial0/1 from LOADING t
o FULL, Loading Done
R6(config-router)#network 192.168.11.0 0.0.0.63 area 51
R6(config-router)#network 192.168.2.0 0.0.0.63 area 0
R6(config-router)#

```

```

R6#conf
Configuring from terminal, memory, or network [terminal]?
Enter configuration commands, one per line. End with CNTL/Z.
R6(config)#ip route 0.0.0.0 0.0.0.0 192.168.2.62
R6(config)#

```

Router 7

```

R7#show ip int br

```

Interface	IP-Address	OK?	Method	Status	Protocol
FastEthernet0/0	172.16.0.1	YES	manual	up	up
Serial0/0	192.168.40.1	YES	manual	up	up
FastEthernet0/1	unassigned	YES	unset	administratively down	down
Serial0/1	192.168.30.1	YES	manual	up	up
FastEthernet1/0	unassigned	YES	unset	up	down
FastEthernet1/1	unassigned	YES	unset	up	down

```

R7#conf t
Enter configuration commands, one per line. End with CNTL/Z.
R7(config)#router ospf 1
R7(config-router)#network 172.16.0.0 0.0.127.255 area 51
R7(config-router)#network 192.168.40.0 0.0.0.3 area 51
R7(config-router)#network 192.168.30.0 0.0.0.3 area 51
R7(config-router)#

```

```

Enter configuration commands, one per line. End with CNTL/Z.
R7(config)#ip route 0.0.0.0 0.0.0.0 192.168.30.2
R7(config)#

```

Router 8

```
R8#show ip int br
```

Interface	IP-Address	OK?	Method	Status	Protocol
FastEthernet0/0	172.16.127.254	YES	manual	up	up
Serial0/0	192.168.20.1	YES	manual	up	up
FastEthernet0/1	unassigned	YES	unset	administratively down	down
Serial0/1	192.168.40.2	YES	manual	up	up
FastEthernet1/0	unassigned	YES	unset	up	down
FastEthernet1/1	unassigned	YES	unset	up	down

```
R8#conf t
Enter configuration commands, one per line. End with CNTL/Z.
R8(config)#router ospf 1
R8(config-router)#network 172.16.0.0 0.0.127.255 area 51
R8(config-router)#
*Mar 1 00:11:47.779: %OSPF-5-ADJCHG: Process 1, Nbr 192.168.40.1 on FastEthe
DING to FULL, Loading Done
R8(config-router)#network 192.168.40.0 0.0.0.3 area 51
R8(config-router)#network 192.168.40.0 0.0.0.3 area 51
*Mar 1 00:12:11.011: %OSPF-5-ADJCHG: Process 1, Nbr 192.168.40.1 on Serial0/
o FULL, Loading Done
R8(config-router)#network 192.168.20.0 0.0.0.3 area 51
R8(config-router)#
```

```
R8#conf t
Enter configuration commands, one per line. End with CNTL/Z.
R8(config)#ip route 0.0.0.0 0.0.0.0 192.168.20.2
R8(config)#
```

- Configuração VPCs:

PC 1:

```
PC1> show ip
```

NAME	: PC1[1]
IP/MASK	: 10.0.1.1/26
GATEWAY	: 10.0.1.62
DNS	:
MAC	: 00:50:79:66:68:00
LPORT	: 10096
RHOST:PORT	: 127.0.0.1:10097
MTU	: 1500

```
PC1> save
Saving startup configuration to startup.vpc
. done
```

PC 2:

```
PC2> show ip

NAME       : PC2[1]
IP/MASK    : 10.0.2.129/27
GATEWAY    : 10.0.2.158
DNS        :
MAC        : 00:50:79:66:68:01
LPORT      : 10098
RHOST:PORT : 127.0.0.1:10099
MTU        : 1500
```

PC 3:

```
PC3> show ip

NAME       : PC3[1]
IP/MASK    : 10.0.3.130/29
GATEWAY    : 10.0.3.134
DNS        :
MAC        : 00:50:79:66:68:02
LPORT      : 10100
RHOST:PORT : 127.0.0.1:10101
MTU        : 1500
```

PC 4:

```
PC4> show ip

NAME       : PC4[1]
IP/MASK    : 192.168.11.1/26
GATEWAY    : 192.168.11.62
DNS        :
MAC        : 00:50:79:66:68:03
LPORT      : 10102
RHOST:PORT : 127.0.0.1:10103
MTU        : 1500
```

PC 5:

```
PC5> show ip

NAME       : PC5[1]
IP/MASK    : 192.168.11.2/26
GATEWAY    : 192.168.11.62
DNS        :
MAC        : 00:50:79:66:68:04
LPORT      : 10104
RHOST:PORT : 127.0.0.1:10105
MTU        : 1500
```

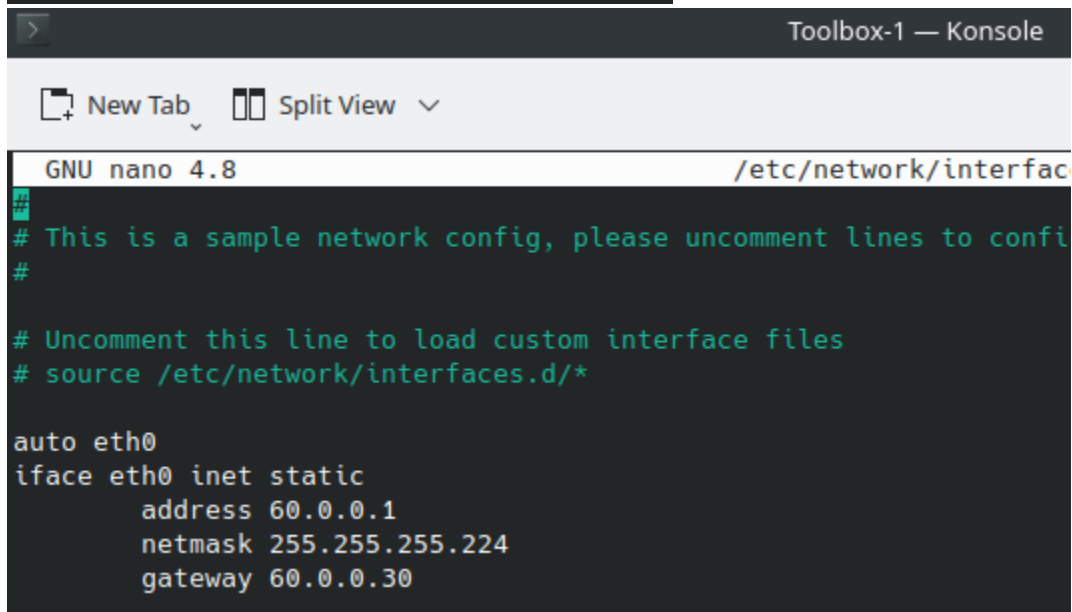
PC 6:

```
PC6> show ip

NAME       : PC6[1]
IP/MASK     : 172.16.0.2/17
GATEWAY     : 172.16.127.254
DNS         :
MAC         : 00:50:79:66:68:05
LPORT      : 10106
RHOST:PORT  : 127.0.0.1:10107
MTU         : 1500
```

- Configuração WebServer

```
auto eth0
iface eth0 inet static
    address 60.0.0.1
    netmask 255.255.255.224
    gateway 60.0.0.30
```

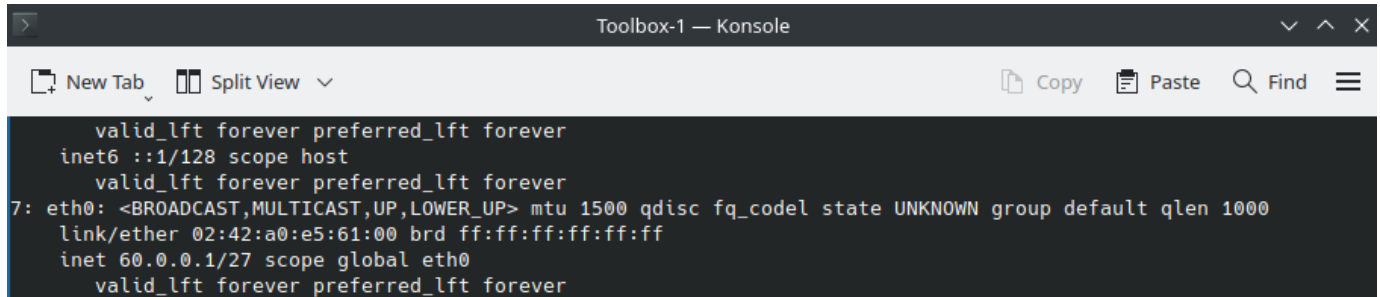


The screenshot shows a terminal window titled "Toolbox-1 — Konsole". The window contains a nano 4.8 editor editing the file `/etc/network/interfaces`. The editor displays a sample network configuration with several commented-out lines and one active configuration block for `eth0`.

```
GNU nano 4.8 /etc/network/interfaces
# This is a sample network config, please uncomment lines to confi
#
# Uncomment this line to load custom interface files
# source /etc/network/interfaces.d/*

auto eth0
iface eth0 inet static
    address 60.0.0.1
    netmask 255.255.255.224
    gateway 60.0.0.30
```

```
root@Toolbox-1:~# nano /root/set-static-ip.sh
root@Toolbox-1:~# /root/set-static-ip.sh
root@Toolbox-1:~# ip a
```



```
valid_lft forever preferred_lft forever
inet6 ::1/128 scope host
valid_lft forever preferred_lft forever
7: eth0: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc fq_codel state UNKNOWN group default qlen 1000
link/ether 02:42:a0:e5:61:00 brd ff:ff:ff:ff:ff:ff
inet 60.0.0.1/27 scope global eth0
valid_lft forever preferred_lft forever
```

4. Evidência de conectividade entre o PC1 e o PC8 (ping), e caminho que os pacotes utilizam entre os dois PCs (fazendo traceroute num dos PCs, usando o comando ‘trace’):

```
PC1> ping 172.16.0.3

172.16.0.3 icmp_seq=1 timeout
84 bytes from 172.16.0.3 icmp_seq=2 ttl=59 time=36.961 ms
84 bytes from 172.16.0.3 icmp_seq=3 ttl=59 time=34.591 ms
84 bytes from 172.16.0.3 icmp_seq=4 ttl=59 time=22.811 ms
84 bytes from 172.16.0.3 icmp_seq=5 ttl=59 time=23.665 ms

PC1> trace 172.16.0.3
trace to 172.16.0.3, 8 hops max, press Ctrl+C to stop
 1  10.0.1.62   8.798 ms  9.350 ms  9.931 ms
 2  10.0.3.134  19.508 ms 19.495 ms 19.499 ms
 3  4.4.4.1    28.243 ms 29.749 ms 19.212 ms
 4  192.168.2.1 29.281 ms 29.785 ms 29.334 ms
 5  192.168.30.1 29.879 ms 29.428 ms 29.917 ms
 6  *172.16.0.3 29.877 ms (ICMP type:3, code:3, Destination port unreachable)
```


5. Evidência de conectividade entre o PC6 e o Servidor Web (ping num dos equipamentos), e caminho que os pacotes utilizam entre os dois (fazendo traceroute num dos equipamentos):

Desligando a ligação R6 e R7, como pedido:

```
R7#sh ip int br
Interface                IP-Address      OK? Method Status          Protocol
FastEthernet0/0          172.16.0.1      YES NVRAM    up              up
Serial0/0                 192.168.40.1    YES NVRAM    up              up
FastEthernet0/1           unassigned      YES NVRAM    administratively down down
Serial0/1                 192.168.30.1    YES NVRAM    administratively down down
```

```
PC6> trace 2.2.2.10
trace to 2.2.2.10, 8 hops max, press Ctrl+C to stop
 1  172.16.127.254    9.759 ms  9.297 ms  10.033 ms
 2  192.168.20.2     9.686 ms  9.351 ms  8.983 ms
 3  192.168.2.62     19.515 ms 19.844 ms 19.180 ms
 4  4.4.127.254      19.534 ms 19.550 ms 19.512 ms
 5  *2.2.2.1        19.476 ms (ICMP type:3, code:3, Destination port unreachable)
```

Fazendo esta desconexão, o caminho não se altera, uma vez que a Default Gateway do PC6 é a interface FastEthernet 0/0 do Router R8.

Fizemos a desconexão entre a interface do Router R8 que estava diretamente conectada ao Router R6, de modo a verificar uma alteração de rota, que não conseguimos verificar anteriormente:

```
R8#
R8#sh ip int br
Interface                IP-Address      OK? Method Status          Protocol
FastEthernet0/0          172.16.127.254  YES NVRAM    up              up
Serial0/0                 192.168.20.1    YES NVRAM    administratively down down
FastEthernet0/1           unassigned      YES NVRAM    administratively down down
Serial0/1                 192.168.40.2    YES NVRAM    up              up
```

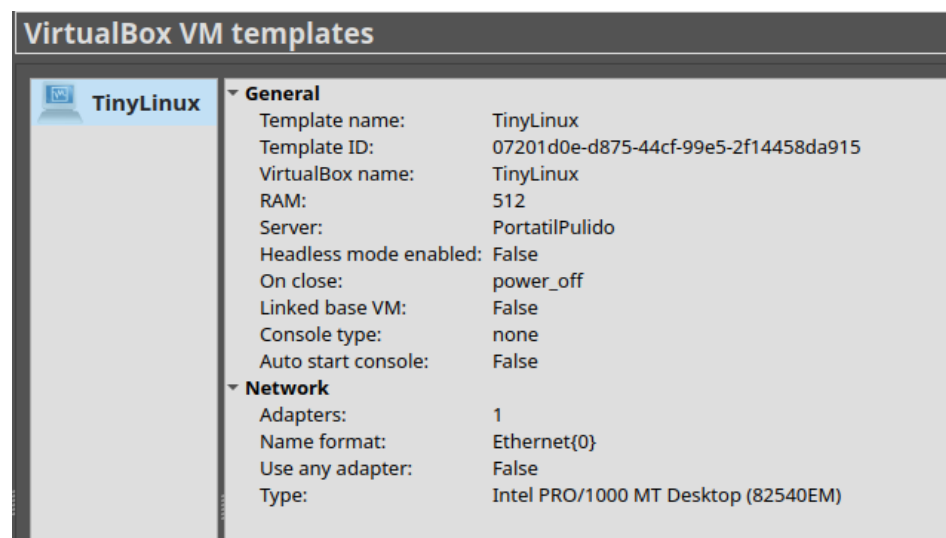
```
PC6> ping 2.2.2.10

2.2.2.10 icmp_seq=1 timeout
2.2.2.10 icmp_seq=2 timeout
84 bytes from 2.2.2.10 icmp_seq=3 ttl=60 time=17.339 ms
84 bytes from 2.2.2.10 icmp_seq=4 ttl=60 time=33.338 ms
84 bytes from 2.2.2.10 icmp_seq=5 ttl=60 time=33.434 ms

PC6> trace 2.2.2.10
trace to 2.2.2.10, 8 hops max, press Ctrl+C to stop
 1      *172.16.127.254    8.493 ms  9.093 ms
 2    172.16.0.1    13.897 ms  9.118 ms  9.683 ms
 3    192.168.30.2    9.153 ms  19.786 ms  9.745 ms
 4    192.168.2.62    29.329 ms  19.776 ms  19.909 ms
 5    4.4.127.254    30.026 ms  29.545 ms  30.124 ms
 6    *2.2.2.1      29.616 ms (ICMP type:3, code:3, Destination port unreachable)
```

Alteração do caminho utilizado entre os pacotes verificada.

6. Utilização de um TinyCore Linux



- Configuração TinyLinux

```

collisions:0 txqueuelen:1000
RX bytes:200 (200,0 B) TX bytes:200 (200,0 B)

tc@box:~$ sudo ifconfig eth0 up
tc@box:~$ sudo ifconfig eth0 172.16.0.3 netmask 255.255.128.0
tc@box:~$ sudo route add default gw 172.16.127.254
tc@box:~$ ifconfig
eth0      Link encap:Ethernet  HWaddr 08:00:27:EF:C9:26
          inet addr:172.16.0.3  Bcast:172.16.127.255  Mask:255.255.128.0
          UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
          RX packets:0 errors:0 dropped:0 overruns:0 frame:0
          TX packets:23 errors:0 dropped:4 overruns:0 carrier:0
          collisions:0 txqueuelen:1000
          RX bytes:0 (0,0 B)  TX bytes:7866 (7,6 KiB)

lo        Link encap:Local Loopback
          inet addr:127.0.0.1  Mask:255.0.0.0
          UP LOOPBACK RUNNING  MTU:65536  Metric:1
          RX packets:4 errors:0 dropped:0 overruns:0 frame:0
          TX packets:4 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:1000
          RX bytes:200 (200,0 B)  TX bytes:200 (200,0 B)

tc@box:~$

```

```

tc@box:~$ wget http://34.223.124.45
Connecting to 34.223.124.45 (34.223.124.45:80)
saving to 'index.html'
index.html  100% |*****| 3961  0:00:00 ETA
'index.html' saved

```

32	40.580931	192.168.250.56	34.223.124.45	TCP	74	40152 → 80 [SYN] Seq=0 Win=64240 Len=0 MS...
33	40.766757	34.223.124.45	192.168.250.56	TCP	74	80 → 40152 [SYN, ACK] Seq=0 Ack=1 Win=268...
34	40.791581	192.168.250.56	34.223.124.45	TCP	66	40152 → 80 [ACK] Seq=1 Ack=1 Win=64256 Le...
35	40.801645	192.168.250.56	34.223.124.45	HTTP	142	GET / HTTP/1.1
36	40.881964	c0:01:21:66:00:01	c0:01:21:66:00:01	LOOP	60	Reply
37	41.434442	192.168.250.56	34.223.124.45	TCP	142	[TCP Retransmission] 40152 → 80 [PSH, ACK...
38	41.618552	34.223.124.45	192.168.250.56	TCP	66	80 → 40152 [ACK] Seq=1 Ack=77 Win=26880 L...
39	41.700881	34.223.124.45	192.168.250.56	TCP	1466	80 → 40152 [ACK] Seq=1 Ack=77 Win=26880 L...
40	41.700940	34.223.124.45	192.168.250.56	TCP	1466	80 → 40152 [ACK] Seq=1401 Ack=77 Win=2688...
41	41.700951	34.223.124.45	192.168.250.56	TCP	1466	80 → 40152 [ACK] Seq=2801 Ack=77 Win=2688...
42	41.700962	34.223.124.45	192.168.250.56	HTTP	134	HTTP/1.1 200 OK (text/html)
43	41.700981	34.223.124.45	192.168.250.56	TCP	66	80 → 40152 [FIN, ACK] Seq=4269 Ack=77 Win...
44	41.725455	192.168.250.56	34.223.124.45	TCP	66	40152 → 80 [ACK] Seq=77 Ack=1401 Win=6700...
45	41.735540	192.168.250.56	34.223.124.45	TCP	66	40152 → 80 [FIN, ACK] Seq=77 Ack=1401 Win...

Início da ligação TCP/estabelecimento da sessão TCP: pacote 32 até 34.

Porto de origem: 40152

Porto de destino: 80 (well-known HTTP port)

- A diferença entre esta pergunta e a 5 consiste em que, na pergunta 5, o ping (ICMP Request and Reply) fica-se apenas pela camada de IP (Network), enquanto que o wget permite o estabelecimento de uma sessão TCP, que fica na camada de

Transporte. Além disto, na pergunta 5, o ping foi feito para o “WebServer”, e aqui para a pergunta 6, utilizámos um IP de um site real do exterior, de forma a conseguir uma sessão HTTP sobre TCP.