

TP4 - Turno 1 - Grupo 05

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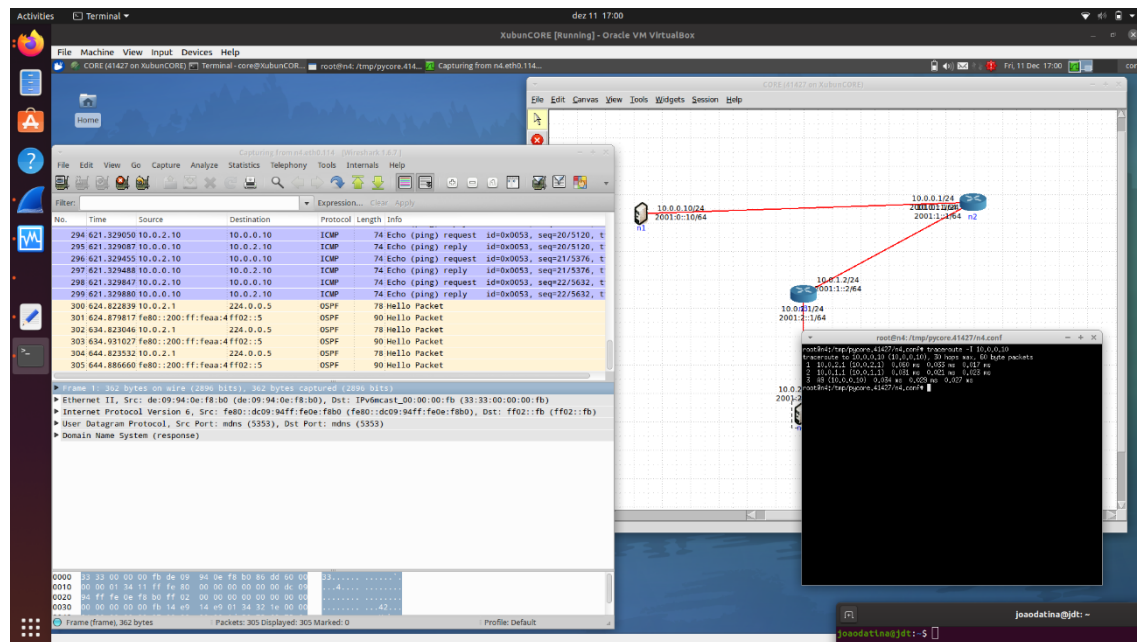
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Parte 1

1.

a)



b)

Face ao comportamento visível as reply têm um TTL muito maior do que as requests, por exemplo 3 e 62 respetivamente.

Echo (ping) request	id=0x0056, seq=7/1792, ttl=3
Echo (ping) reply	id=0x0056, seq=7/1792, ttl=62
Echo (ping) request	id=0x0056, seq=8/2048, ttl=3
Echo (ping) reply	id=0x0056, seq=8/2048, ttl=62
Echo (ping) request	id=0x0056, seq=9/2304, ttl=3
Echo (ping) reply	id=0x0056, seq=9/2304, ttl=62

c)

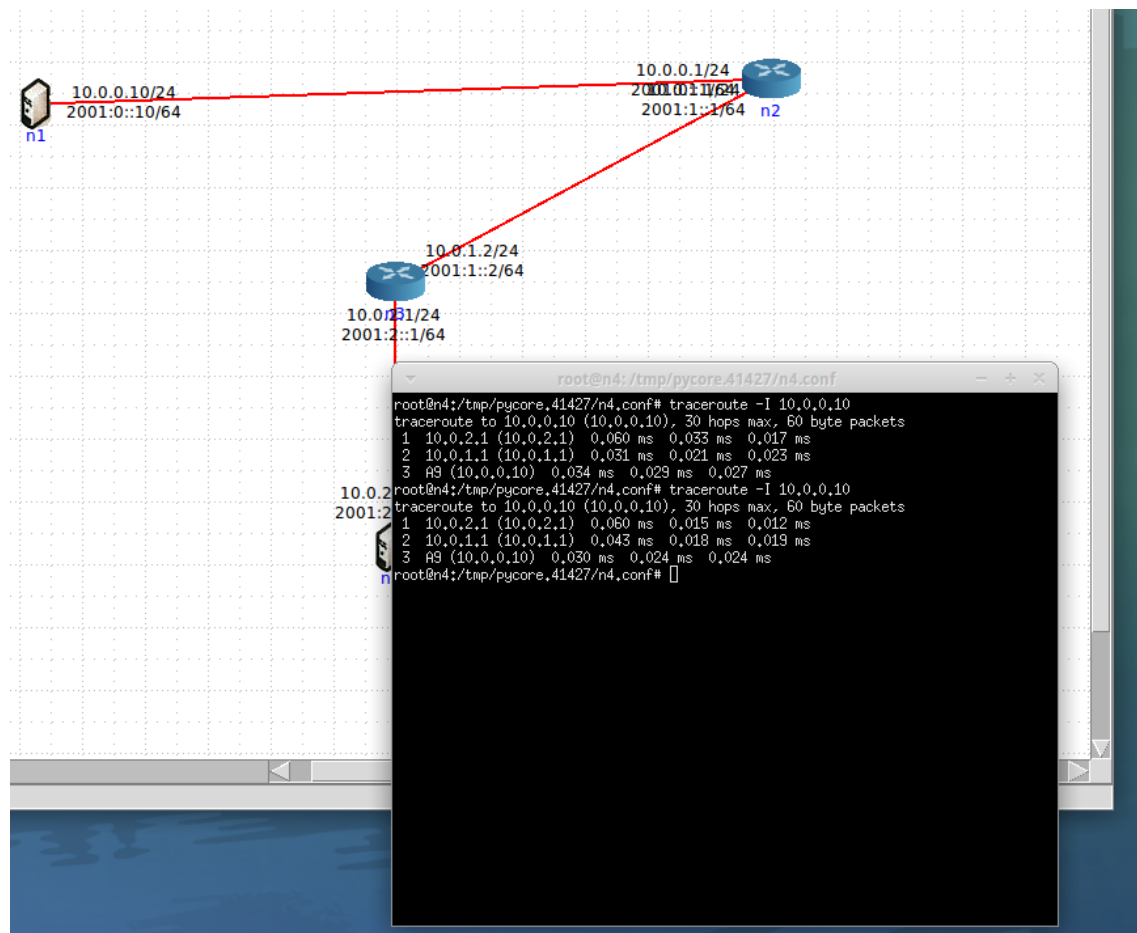
O valor inicial mínimo do campo TTL é 1, sendo que o valor mínimo para a transação n4 para n1 é 3.

- ▶ Differentiated Services Field: 0x00 (DSCP 0x00: Default; Total Length: 60 Identification: 0xe66f (58991))
- ▶ Flags: 0x00
Fragment offset: 0
- ▼ Time to live: 3
 - ▶ [Expert Info (Note/Sequence): "Time To Live" only 3]
Protocol: ICMP (1)
- ▶ Header checksum: 0xbb3e [correct]
Source: 10.0.2.10 (10.0.2.10)
Destination: 10.0.0.10 (10.0.0.10)

d)

$$[(0.060+0.033+0.017) + (0.031+0.021+0.023) + (0.034+0.029+0.027)] / 3 = 0.275 / 3 = 0.09166$$

ms é o tempo médio de ida e volta RTT.



2.

a)

O IP do destino é 193.136.9.240 e o de origem é 192.168.1.1 .

```
turriakali:~$ sudo traceroute -I marco.uminho.pt 3000
traceroute to marco.uminho.pt (193.136.9.240), 30 hops max, 3000 byte packets
 1 vodafonegw (192.168.1.1)  0.976 ms  0.935 ms  2.021 ms
 2 2.0.60.94.rev.vodafone.pt (94.60.0.2)  4.994 ms  4.949 ms  4.904 ms
 3 113.41.30.213.rev.vodafone.pt (213.30.41.113)  4.731 ms  5.020 ms  5.418 ms
 4 FCCN.AS1930.gigapix.pt (193.136.251.1)  11.169 ms  11.248 ms  11.272 ms
 5 Router60.Lisboa.fccn.pt (194.210.6.202)  12.537 ms  12.497 ms  12.386 ms
 6 Router43.Backbone2.Porto.fccn.pt (193.136.4.2)  15.354 ms  12.781 ms  13.334 ms
 7 ROUTER42.10GE.Porto.fccn.pt (193.137.4.26)  12.653 ms  15.517 ms  13.258 ms
 8 Uminho.Braga.fccn.pt (193.136.4.100)  15.254 ms  15.363 ms  14.626 ms
 9 * * *
10 * * *
11 * * *
12 marco.uminho.pt (193.136.9.240)  17.340 ms  17.267 ms  17.215 ms
```

b)

O valor do campo do protocolo é 8 e significa que é um Echo Request.

```
Internet Control Message Protocol
  Type: 8 (Echo (ping) request)
  Code: 0
  Checksum: 0x7c7e [correct]
  [Checksum Status: Good]
  Identifier (BE): 1531 (0x05fb)
  Identifier (LE): 64261 (0xfb05)
  Sequence number (BE): 1 (0x0001)
  Sequence number (LE): 256 (0x0100)
  [No response seen]
  Data (32 bytes)
```

c)

O cabeçalho IPV4 tem 20 bytes, 32 bytes são usados pelo payload, este é obtido com a subtração do tamanho do pacote com o tamanho dos cabeçalhos.

```
Internet Protocol Version 4, Src: 192.168.1.224, Dst: 193.136.9.240
  0100 .... = Version: 4
  .... 0101 = Header Length: 20 bytes (5)
  Differentiated Services Field: 0x00 (DSCP: CS0, ECN: Not-ECT)
    Total Length: 40
    Identification: 0xb016 (45078)
  Flags: 0x0172
    Fragment offset: 2960
  Time to live: 1
    Protocol: ICMP (1)
    Header checksum: 0x7a4c [validation disabled]
    [Header checksum status: Unverified]
    Source: 192.168.1.224
    Destination: 193.136.9.240
  [3 IPv4 Fragments (2980 bytes): #23(1480), #24(1480), #25(20)]
```

```

Internet Control Message Protocol
  Type: 8 (Echo (ping) request)
  Code: 0
  Checksum: 0x7c7e [correct]
  [Checksum Status: Good]
  Identifier (BE): 1531 (0x05fb)
  Identifier (LE): 64261 (0xfb05)
  Sequence number (BE): 1 (0x0001)
  Sequence number (LE): 256 (0x0100)
  ▶ [No response seen]
  ▶ Data (32 bytes)

```

d)

O datagrama IP não é fragmentado porque não existe um Fragment Offset.

```

Identification: 0x0000 (00000)
  Flags: 0x0000
    0... .. = Reserved bit: Not set
    .0... .. = Don't fragment: Not set
    ..0... .. = More fragments: Not set
    Fragment offset: 0
  ▶ Time to live: 1

```

e)

O campo id incrementa de 1 a 1 pacote e o campo TTL incrementa de 3 em 3 pacotes.

```

Total Length: 40
  Identification: 0xb016 (45078)
  ▶ Flags: 0x0172
  Fragment offset: 2960
  ▶ Time to live: 1
  Destination: 192.168.1.224

```

f)

O valor do campo TTL 255, o valor não se mantém constante porque a cada resposta falhada o valor de TTL decrementa aproximando-se ao seu valor mínimo.

```

.... 0101 = Header Length: 20 bytes (5)
  ▶ Differentiated Services Field: 0x00 (DSCP: CS0, ECN: Not-ECT)
  Total Length: 96
  Identification: 0xc14e (49486)
  ▶ Flags: 0x0000
  Fragment offset: 0
  Time to live: 251
  Protocol: ICMP (1)
  Header checksum: 0x7229 [validation disabled]
  [Header checksum status: Unverified]
  Source: 194.210.6.202
  Destination: 192.168.1.224

```

3.

a)

Sim, a mensagem foi fragmentada devido ao tamanho do pacote.

b)

As flags indicam que foi fragmentado. O facto de o offset ser 0 leva-nos a concluir que se trata do primeiro fragmento. O datagrama IP tem um tamanho 1514.

```
Internet Protocol version 4, Src: 192.168.1.224, Dst: 193.136.9.240
  0100 .... = Version: 4
  .... 0101 = Header Length: 20 bytes (5)
  ▶ Differentiated Services Field: 0x00 (DSCP: CS0, ECN: Not-ECT)
    Total Length: 1500
    Identification: 0x083b (2107)
  ▼ Flags: 0x2000, More fragments
    0... .. = Reserved bit: Not set
    .0... .. = Don't fragment: Not set
    ..1. .... = More fragments: Set
    Fragment offset: 0
  ▶ Time to live: 1
    Protocol: ICMP (1)
    Header checksum: 0xfde5 [validation disabled]
    [Header checksum status: Unverified]
    Source: 192.168.1.224
    Destination: 193.136.9.240
    [Reassembled IPv4 in frame: 14]
  ▼ Data (1480 bytes)
    Data: 0800a96806ec000148494a4b4c4d4e4f5051525354555657...
    [Length: 1480]
```

```
Frame 13: 1514 bytes on wire (12112 bits), 1514 bytes captured (12112 bits) on interface eth0, id 0
Ethernet II, Src: PcsCompu_c0:49:9a (08:00:27:c0:49:9a), Dst: HuaweiTe_85:01:83 (ac:75:1d:85:01:83)
Internet Protocol Version 4, Src: 192.168.1.224, Dst: 193.136.9.240
```

c)

Não se trata do 1º fragmento porque o valor do offset é diferente de 0 e há mais fragmentos porque o valor de More Fragments é Set.

```
Internet Protocol Version 4, Src: 192.168.1.224, Dst: 193.136.9.240
  0100 .... = Version: 4
  .... 0101 = Header Length: 20 bytes (5)
  ▶ Differentiated Services Field: 0x00 (DSCP: CS0, ECN: Not-ECT)
    Total Length: 1500
    Identification: 0x083b (2107)
  ▼ Flags: 0x20b9, More fragments
    0... .. = Reserved bit: Not set
    .0... .. = Don't fragment: Not set
    ..1. .... = More fragments: Set
    Fragment offset: 1480
  ▶ Time to live: 1
    Protocol: ICMP (1)
    Header checksum: 0xfde5 [validation disabled]
    [Header checksum status: Unverified]
    Source: 192.168.1.224
    Destination: 193.136.9.240
    [Reassembled IPv4 in frame: 14]
```

d)

Foram criados 3 fragmentos, e é possível detetar o último fragmento por ter More Fragments: Not Set.

```
Protocol: ICMP (1)
Header checksum: 0x2223 [validation disabled]
[Header checksum status: Unverified]
Source: 192.168.1.224
Destination: 193.136.9.240
▼ [3 IPv4 Fragments (2985 bytes): #12(1480), #13(1480), #14(25)]
  [Frame: 12, payload: 0-1479 (1480 bytes)]
  [Frame: 13, payload: 1480-2959 (1480 bytes)]
  [Frame: 14, payload: 2960-2984 (25 bytes)]
  [Fragment count: 3]
  [Reassembled IPv4 length: 2985]
  [Reassembled IPv4 data: 0800a96806ec000148494a4b4c4d4e4f5051525354555657...]
```

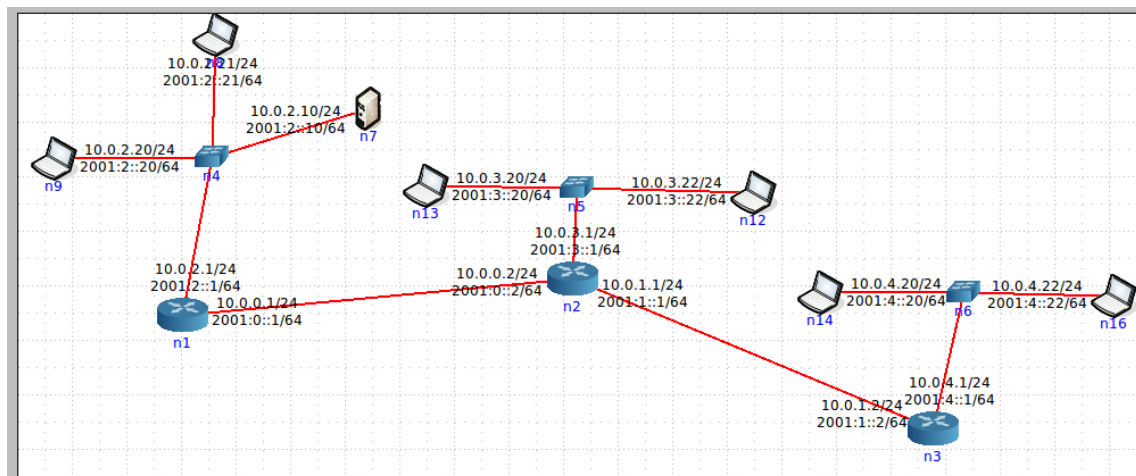
e)

Os campos que mudam são as flags, conseguimos identificar o primeiro, por o Offset ser 0, e o último o More Fragments: Not Set. Os restantes são organizados por ordem crescente do tamanho do Offset.

Parte 2

1.

a)



b)

Trata-se de endereços privados, porque se encontram no range 10.0.0.1 até 10.255.255.255.

c)

A comunicação entre dispositivos ligados a um switch é feita na base de ethernet packets, que não usam IP.

d)

The image shows three terminal windows from different hosts (n8, n12, n16) in a network topology. Each window displays the output of a 'ping 10.0.2.10' command. Host n8 shows successful pings with 0% packet loss. Host n12 shows a 25% packet loss. Host n16 shows successful pings with 0% packet loss. The background is a blue wall with a mountain silhouette.

```
root@n8:/tmp/pycore.34247/n8.conf# ping 10.0.2.10
PING 10.0.2.10 (10.0.2.10) 56(84) bytes of data.
64 bytes from 10.0.2.10: icmp_req=1 ttl=64 time=0.048 ms
64 bytes from 10.0.2.10: icmp_req=2 ttl=64 time=0.023 ms
64 bytes from 10.0.2.10: icmp_req=3 ttl=64 time=0.036 ms
64 bytes from 10.0.2.10: icmp_req=4 ttl=64 time=0.046 ms
64 bytes from 10.0.2.10: icmp_req=5 ttl=64 time=0.040 ms
^C
--- 10.0.2.10 ping statistics ---
5 packets transmitted, 5 received, 0% packet loss, time 3997ms
rtt min/avg/max/ndev = 0.023/0.038/0.048/0.011 ms
root@n8:/tmp/pycore.34247/n8.conf#
```

```
root@n12:/tmp/pycore.34247/n12.conf# ping 10.0.2.10
PING 10.0.2.10 (10.0.2.10) 56(84) bytes of data.
64 bytes from 10.0.2.10: icmp_req=3 ttl=62 time=0.058 ms
64 bytes from 10.0.2.10: icmp_req=4 ttl=62 time=0.040 ms
64 bytes from 10.0.2.10: icmp_req=5 ttl=62 time=0.039 ms
64 bytes from 10.0.2.10: icmp_req=6 ttl=62 time=0.023 ms
64 bytes from 10.0.2.10: icmp_req=7 ttl=62 time=0.042 ms
64 bytes from 10.0.2.10: icmp_req=8 ttl=62 time=0.051 ms
^C
--- 10.0.2.10 ping statistics ---
8 packets transmitted, 6 received, 25% packet loss, time 900ms
rtt min/avg/max/ndev = 0.029/0.043/0.058/0.010 ms
root@n12:/tmp/pycore.34247/n12.conf#
```

```
root@n16:/tmp/pycore.34247/n16.conf# ping 10.0.2.10
PING 10.0.2.10 (10.0.2.10) 56(84) bytes of data.
64 bytes from 10.0.2.10: icmp_req=1 ttl=61 time=0.087 ms
64 bytes from 10.0.2.10: icmp_req=2 ttl=61 time=0.046 ms
64 bytes from 10.0.2.10: icmp_req=3 ttl=61 time=0.049 ms
64 bytes from 10.0.2.10: icmp_req=4 ttl=61 time=0.116 ms
64 bytes from 10.0.2.10: icmp_req=5 ttl=61 time=0.050 ms
^C
--- 10.0.2.10 ping statistics ---
5 packets transmitted, 5 received, 0% packet loss, time 2990ms
rtt min/avg/max/ndev = 0.046/0.069/0.116/0.029 ms
root@n16:/tmp/pycore.34247/n16.conf#
```

2.

a)

As tabelas representam os endereços das redes registradas no kernel. Para o router vemos várias entradas, cada uma delas representa uma das redes do departamento e a ligação aos routers de cada departamento.

The image shows two terminal windows displaying the kernel IP routing table for hosts n1 and n9. Host n1's table shows routes to 10.0.0.0, 10.0.1.0, 10.0.2.0, 10.0.3.0, and 10.0.4.0, all with gateway 10.0.0.2 and interface eth0. Host n9's table shows a default route (0.0.0.0) with gateway 10.0.2.1 and interface eth0, and a specific route to 10.0.2.0 with gateway 0.0.0.0 and interface eth1. A red arrow points from the 10.0.2.0 entry in n9's table to a diagram below.

```
root@n1:/tmp/pycore.34247/n1.conf# netstat -rn
Kernel IP routing table
Destination Gateway Genmask Flags MSS Window irtt Iface
10.0.0.0 0.0.0.0 255.255.255.0 U 0 0 0 eth0
10.0.1.0 10.0.0.2 255.255.255.0 UG 0 0 0 eth0
10.0.2.0 0.0.0.0 255.255.255.0 U 0 0 0 eth1
10.0.3.0 10.0.0.2 255.255.255.0 UG 0 0 0 eth0
10.0.4.0 10.0.0.2 255.255.255.0 UG 0 0 0 eth0
root@n1:/tmp/pycore.34247/n1.conf#
```

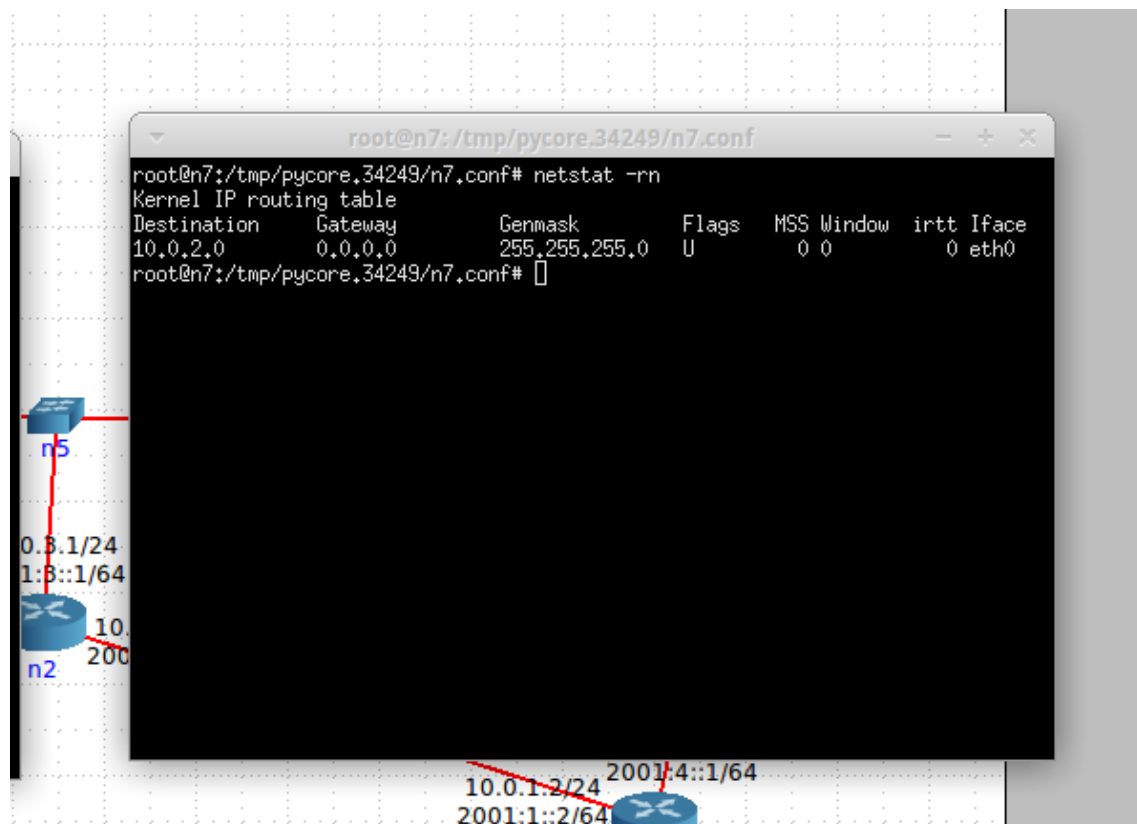
```
root@n9:/tmp/pycore.34247/n9.conf# netstat -rn
Kernel IP routing table
Destination Gateway Genmask Flags MSS Window irtt Iface
0.0.0.0 10.0.2.1 0.0.0.0 UG 0 0 0 eth0
10.0.2.0 0.0.0.0 255.255.255.0 U 0 0 0 eth0
root@n9:/tmp/pycore.34247/n9.conf#
```

b)

É um encaminhamento estático porque o destino é default (0.0.0.0), estando assim já predefinido.

c)

Não é possível estabelecer comunicação de e para o host entre dispositivos fora do departamento.



d)

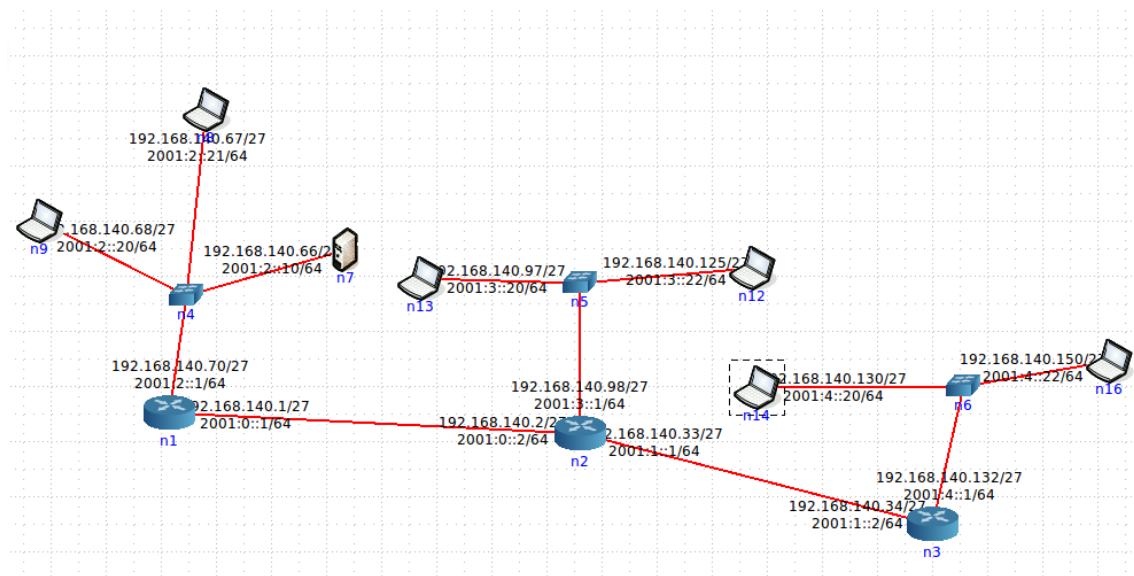
```
Kernel IP routing table
Destination Gateway Genmask Flags MSS Window irtt Iface
10.0.2.0 0.0.0.0 255.255.255.0 U 0 0 0 eth0
root@n7: /tmp/pycore.34250/n7.conf# route add default gw 10.0.2.1
root@n7: /tmp/pycore.34250/n7.conf# netstat -rn
Kernel IP routing table
Destination Gateway Genmask Flags MSS Window irtt Iface
0.0.0.0 10.0.2.1 0.0.0.0 UG 0 0 0 eth0
10.0.2.0 0.0.0.0 255.255.255.0 U 0 0 0 eth0
root@n7: /tmp/pycore.34250/n7.conf#
```


e)

```
root@n7:/tmp/pycore.34250/n7.conf# ping 10.0.3.20
PING 10.0.3.20 (10.0.3.20) 56(84) bytes of data.
64 bytes from 10.0.3.20: icmp_req=1 ttl=62 time=0.042 ms
64 bytes from 10.0.3.20: icmp_req=2 ttl=62 time=0.051 ms
64 bytes from 10.0.3.20: icmp_req=3 ttl=62 time=0.039 ms
64 bytes from 10.0.3.20: icmp_req=4 ttl=62 time=0.058 ms
^C
--- 10.0.3.20 ping statistics ---
4 packets transmitted, 4 received, 0% packet loss, time 2999ms
rtt min/avg/max/mdev = 0.039/0.047/0.058/0.010 ms
root@n7:/tmp/pycore.34250/n7.conf# netstat -rn
Kernel IP routing table
Destination        Gateway           Genmask          Flags   MSS Window  irtt Iface
0.0.0.0            10.0.2.1         0.0.0.0          UG      0 0        0 eth0
10.0.2.0           0.0.0.0         255.255.255.0    U        0 0        0 eth0
root@n7:/tmp/pycore.34250/n7.conf#
```

3. Definição de Sub-redes

1)



2)

Como existem 5 redes a máscara usada foi 255.255.255.224, porque o número mais próximo de 5 e que permite englobar essas sub-redes é 6 = (2^3-2) sub-redes.

3)

$2^5-2=30$ porque o número de host IP é 2^n-2 sendo que n é o número de bits para o host.

4)

```
root@n13:/tmp/pycore.34260/n13.conf# ping 192.168.140.66
PING 192.168.140.66 (192.168.140.66) 56(84) bytes of data.
64 bytes from 192.168.140.66: icmp_req=1 ttl=64 time=0.030 ms
64 bytes from 192.168.140.66: icmp_req=2 ttl=64 time=0.026 ms
64 bytes from 192.168.140.66: icmp_req=3 ttl=64 time=0.031 ms
64 bytes from 192.168.140.66: icmp_req=4 ttl=64 time=0.032 ms
64 bytes from 192.168.140.66: icmp_req=5 ttl=64 time=0.033 ms
64 bytes from 192.168.140.66: icmp_req=6 ttl=64 time=0.040 ms
^C
--- 192.168.140.66 ping statistics ---
6 packets transmitted, 6 received, 0% packet loss, time 4996ms
rtt min/avg/max/mdev = 0.026/0.032/0.040/0.004 ms
root@n13:/tmp/pycore.34260/n13.conf#
```

```
root@n14:/tmp/pycore.34260/n14.conf# ping 192.168.140.66
PING 192.168.140.66 (192.168.140.66) 56(84) bytes of data.
64 bytes from 192.168.140.66: icmp_req=1 ttl=64 time=0.024 ms
64 bytes from 192.168.140.66: icmp_req=2 ttl=64 time=0.028 ms
64 bytes from 192.168.140.66: icmp_req=3 ttl=64 time=0.027 ms
64 bytes from 192.168.140.66: icmp_req=4 ttl=64 time=0.027 ms
64 bytes from 192.168.140.66: icmp_req=5 ttl=64 time=0.029 ms
^C
--- 192.168.140.66 ping statistics ---
5 packets transmitted, 5 received, 0% packet loss, time 3996ms
rtt min/avg/max/mdev = 0.024/0.027/0.029/0.001 ms
root@n14:/tmp/pycore.34260/n14.conf#
```

```
root@n9:/tmp/pycore.34260/n9.conf# ping 192.168.140.66
PING 192.168.140.66 (192.168.140.66) 56(84) bytes of data.
64 bytes from 192.168.140.66: icmp_req=1 ttl=64 time=0.025 ms
64 bytes from 192.168.140.66: icmp_req=2 ttl=64 time=0.028 ms
64 bytes from 192.168.140.66: icmp_req=3 ttl=64 time=0.027 ms
64 bytes from 192.168.140.66: icmp_req=4 ttl=64 time=0.029 ms
64 bytes from 192.168.140.66: icmp_req=5 ttl=64 time=0.031 ms
^C
--- 192.168.140.66 ping statistics ---
5 packets transmitted, 5 received, 0% packet loss, time 3997ms
rtt min/avg/max/mdev = 0.025/0.028/0.031/0.002 ms
root@n9:/tmp/pycore.34260/n9.conf#
```

Conclusão

Este trabalho deu, aos elementos do grupo, um maior conhecimento de ICMP e IPV4 e também maior experiência a desenvolver topologias mais complexas no Core.