Static routing – ruting statyczny

- W ramach zajęć należy stworzyć prostą sieć składającą się z czterech maszyn wirtualnych – dwóch komputerów (PC1 I PC2) oraz dwóch ruterów (R1 i R2).
  - Adresy IP poszczególnych interfejsów urządzeń zostały już skonfigurowane, należy sprawdzić poprawność tej konfiguracji
  - Należy zbadać łączność pomiędzy urządzeniami końcowymi z użyciem polecenia **`ping`** i sprawdzić zawartość tablic rutingu z użyciem polecenia **`route`**
  - Należy uzupełnić konfigurację urządzeń w taki sposób, aby ruting statyczny działał poprawnie
  - Należy użyć programu **`tcpdump`** w celach diagnostycznych
- Działania te powinny umożliwić komunikację komputerów za pośrednictwem sieci

Static routing – ruting statyczny

- **Głównym celem zajęć jest**
  - skonfigurowanie rutingu statycznego
  - analiza działania rutingu statycznego
  - lepsze zapoznanie się ze środowiskiem **`kathara`**

Università degli Studi Roma Tre
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kathara lab

static-routing

Version	1.1
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Web	https://www.kathara.org/
Description	an example of configuration of static routes – kathara version of netkit lab static-routing vers. 2.2

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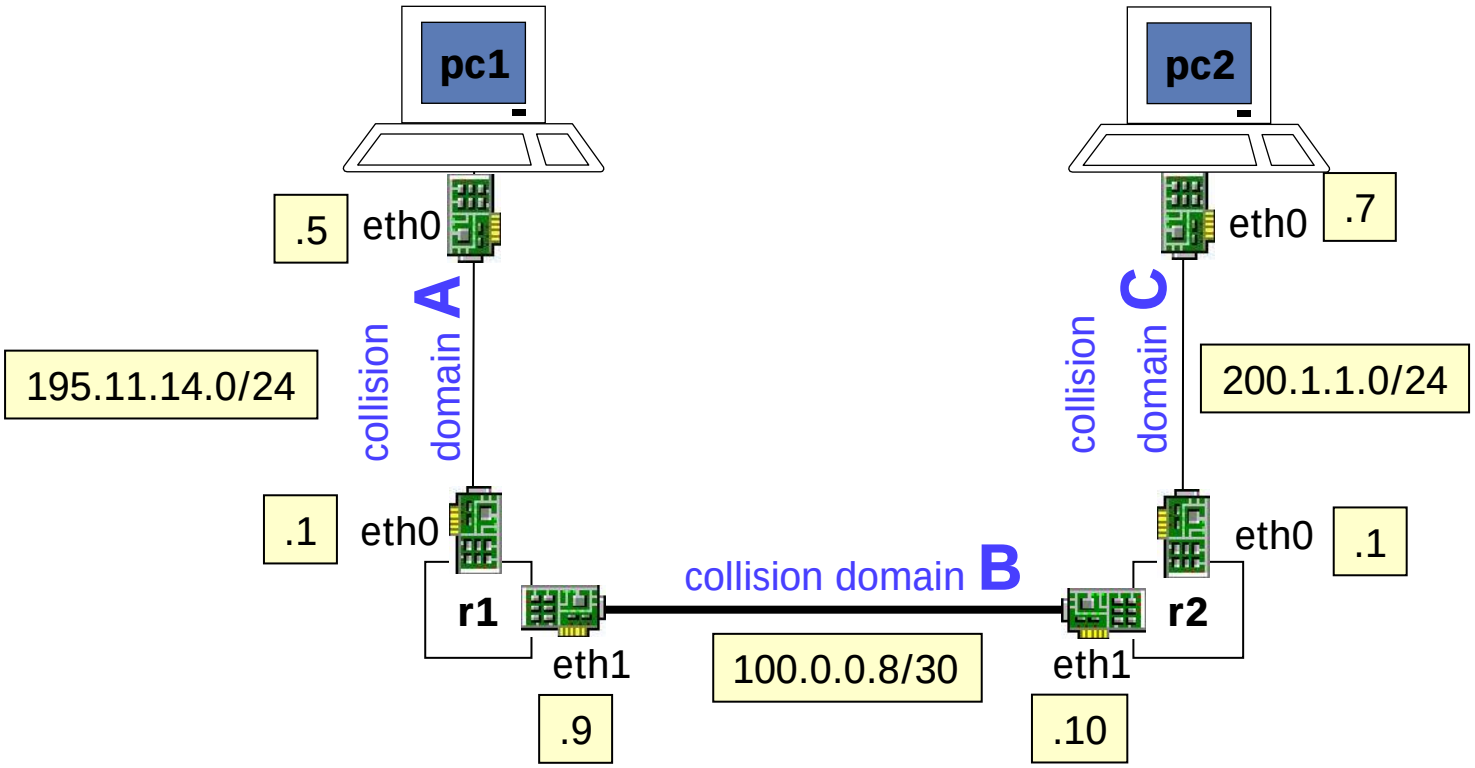
Lab Scenario Personalization

- Please modify the default scenario in the following way
  - In the next slide change the name of `r1` to `r<LAB-ID>` for each configuration file, where LAB-ID is your personal ID assigned by the lab instructor
- **Note well**: from now-on
  - Command-line commands should reflect the change in naming, therefore there can be differences in the outputs shown in the manual

Step 1 – Network topology



Step 2 – The lab

- lab directory hierarchy
  - lab.conf
  - pc1.startup
  - pc2.startup
  - r1.startup
  - r2.startup

Step 2 – The lab

lab.conf

```
r1[0]=A
r1[1]=B

r2[0]=C
r2[1]=B

pc1[0]=A
pc2[0]=C
```

pc1.startup

```
ifconfig eth0 195.11.14.5/24 up
```

pc2.startup

```
ifconfig eth0 200.1.1.7/24 up
```

r1.startup

```
ifconfig eth0 195.11.14.1/24 up
ifconfig eth1 100.0.0.9/30 up
```

r2.startup

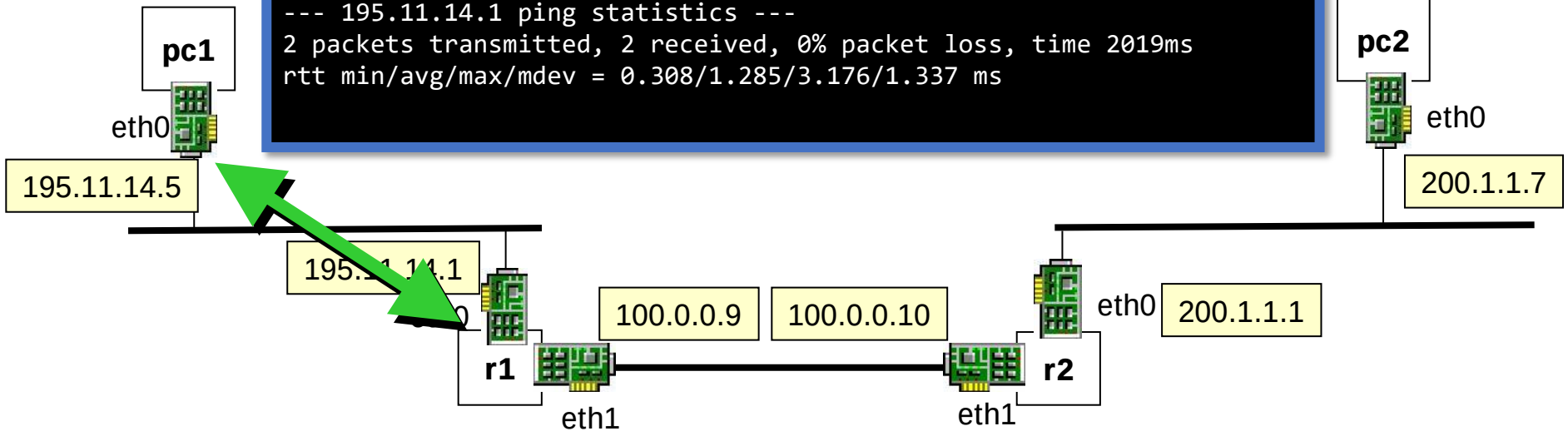
```
ifconfig eth0 200.1.1.1/24 up
ifconfig eth1 100.0.0.10/30 up
```

Step 3 – Testing connectivity

interfaces on the same domain can reach each other

```
root@pc1:~$ ping 195.11.14.1
PING 195.11.14.1 (195.11.14.1) 56(84) bytes of data.
64 bytes from 195.11.14.1: icmp_seq=1 ttl=64 time=3.17 ms
64 bytes from 195.11.14.1: icmp_seq=2 ttl=64 time=0.371 ms

--- 195.11.14.1 ping statistics ---
2 packets transmitted, 2 received, 0% packet loss, time 2019ms
rtt min/avg/max/mdev = 0.308/1.285/3.176/1.337 ms
```

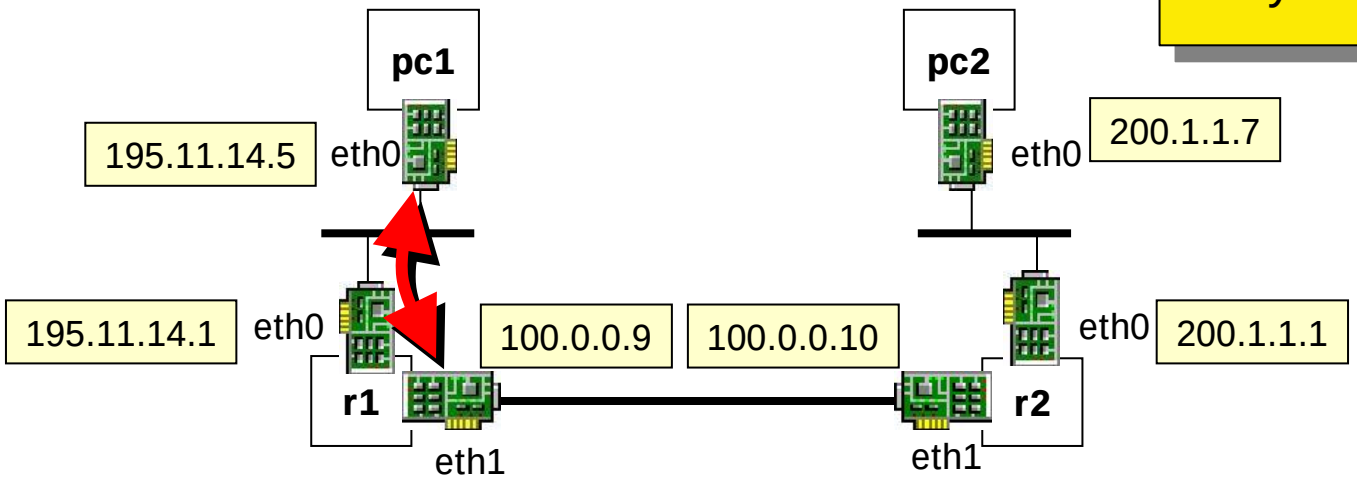


Step 3 – Testing connectivity

```
root@pc1:~$ ping 100.0.0.9
connect: Network is unreachable
```

interfaces on different domains cannot be reached

can you tell why?



Step 3 – Inspecting routing tables

- Both routers and PCs don't know how to reach networks that are not directly connected to them

```
root@r1:~$ route -n
Kernel IP routing table
Destination     Gateway         Genmask         Flags Metric Ref    Use Iface
100.0.0.8       *               255.255.255.252 U     0      0        0 eth1
195.11.14.0     *               255.255.255.0   U     0      0        0 eth0
```

- Directly connected networks are automatically inserted into the routing table when the corresponding interface is brought up
- This is a common behavior of all IP devices (even real-world routers!)

Step 4 – Default routes on PCs

- To fix the problem we could specify the default route on the pcs: “through this gateway (IP number) you can reach all the other networks”

```
root@pc1:~$ route add default gw 195.11.14.1
root@pc1:~$ route -n
Kernel IP routing table
Destination     Gateway         Genmask         Flags Metric Ref    Use Iface
195.11.14.0     *               255.255.255.0   U     0      0        0 eth0
default         195.11.14.1     0.0.0.0         UG    0      0        0 eth0
```

```
root@pc2:~$ route add default gw 200.1.1.1
root@pc2:~$ route -n
Kernel IP routing table
Destination     Gateway         Genmask         Flags Metric Ref    Use Iface
200.1.1.0       *               255.255.255.0   U     0      0        0 eth0
default         200.1.1.1       0.0.0.0         UG    0      0        0 eth0
```

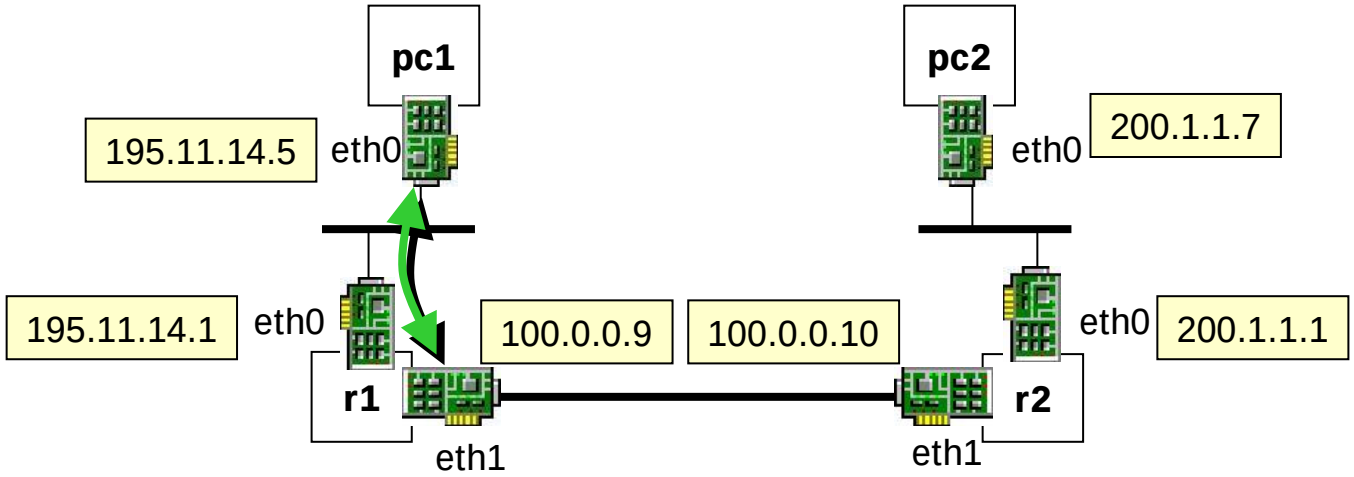
Step 4 – Default routes on PCs: test

pc1

```
pc1:~# ping 100.0.0.9
PING 100.0.0.9 (100.0.0.9) 56(84) bytes of data.
64 bytes from 100.0.0.9: icmp_seq=1 ttl=64 time=0.451 ms
64 bytes from 100.0.0.9: icmp_seq=2 ttl=64 time=0.299 ms
64 bytes from 100.0.0.9: icmp_seq=3 ttl=64 time=0.320 ms

--- 100.0.0.9 ping statistics ---
3 packets transmitted, 3 received, 0% packet loss, time 2003ms
rtt min/avg/max/mdev = 0.299/0.356/0.451/0.070 ms
pc1:~#
```

the "backbone interface" of **r1** is reachable



Step 4 – Default routes on PCs: test

pc1

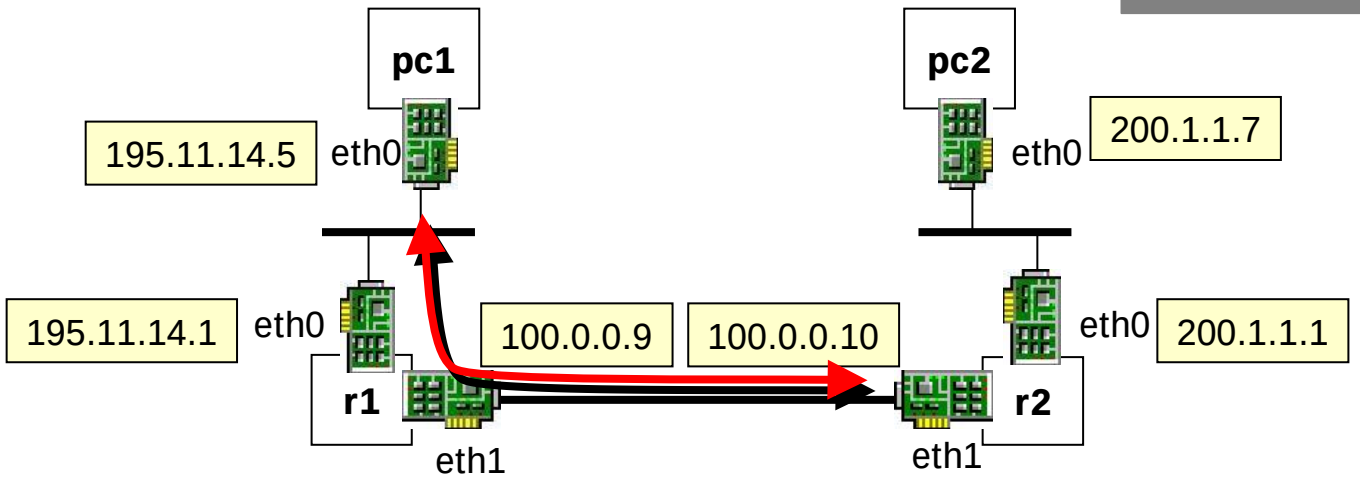
```
pc1:~# ping 100.0.0.10
PING 100.0.0.10 (100.0.0.10) 56(84) bytes of data.

--- 100.0.0.10 ping statistics ---
7 packets transmitted, 0 received, 100% packet loss, time 6105ms

pc1:~#
```

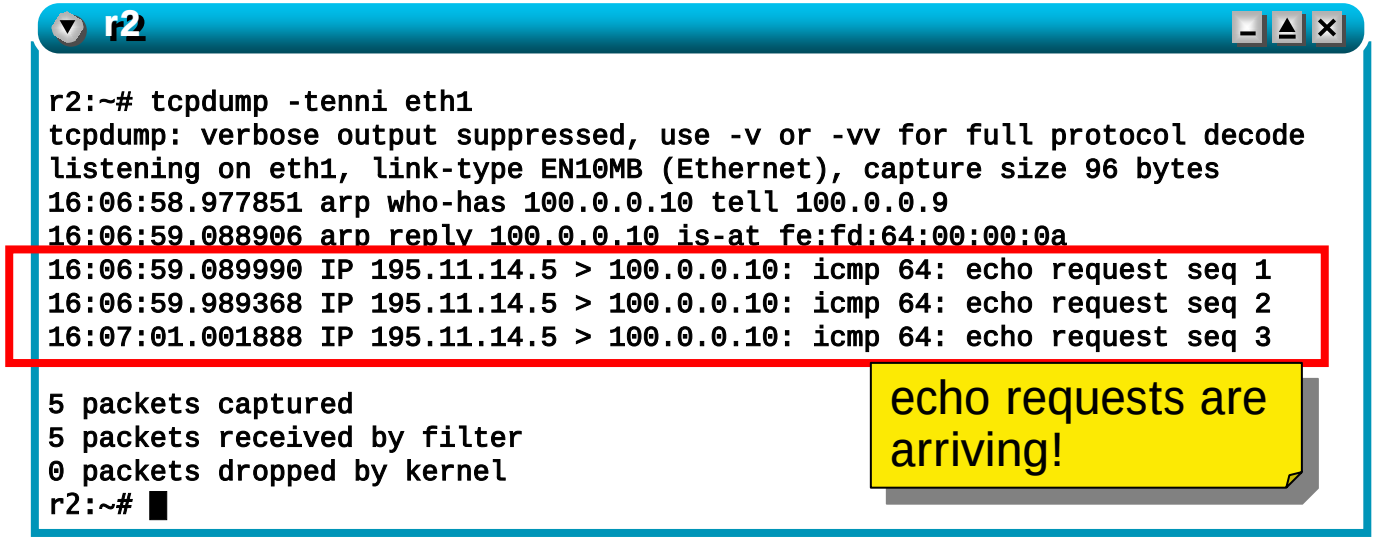
interfaces on **r2** seem unreachable!

can you tell why?



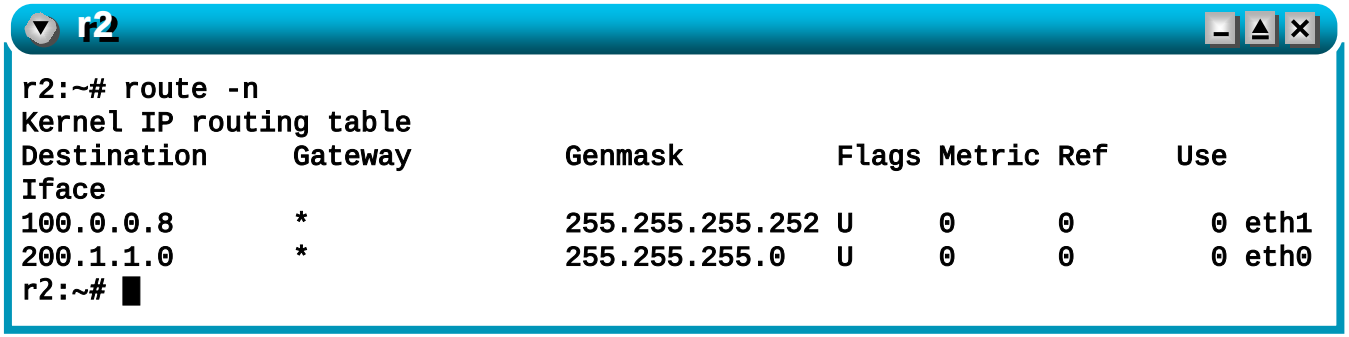
Step 4 – Let's inspect the network

- Do echo request packets reach **`r2`**?
- Let's check…
  - While pinging from **`pc1`** 100.0.0.10 sniff on interface **`eth1`** of **`r2`**

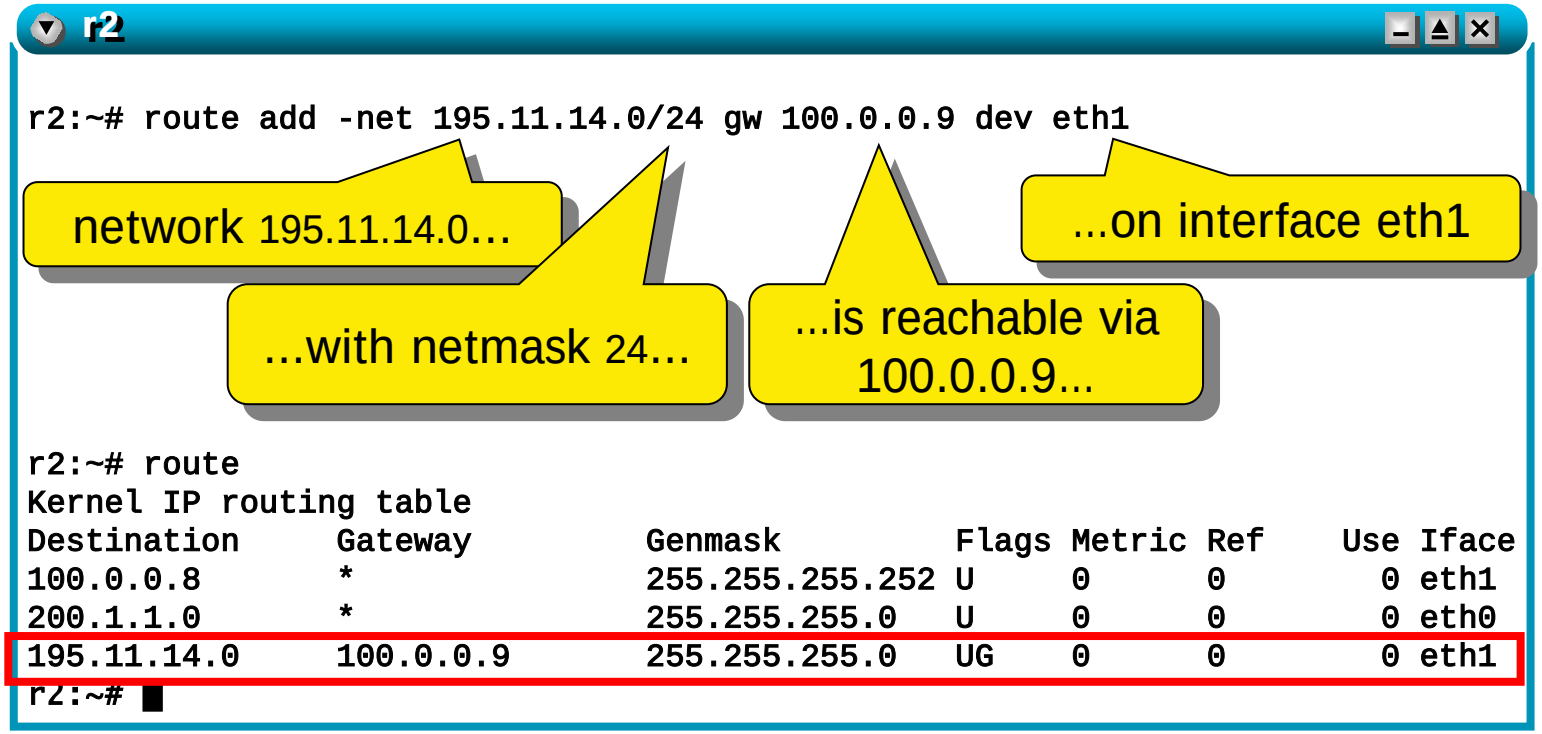


Step 4 – **r2**'s routing table

- **pc1**'s address is 195.11.14.5
- **r2** does not know how to reach such an address.
- Echo requests arrive to **r2** but **r2** does not know where echo replies should be forwarded!
- Somebody should teach **r2** how to reach **pc1**
- We may insert a static route into the routing table of **r2**

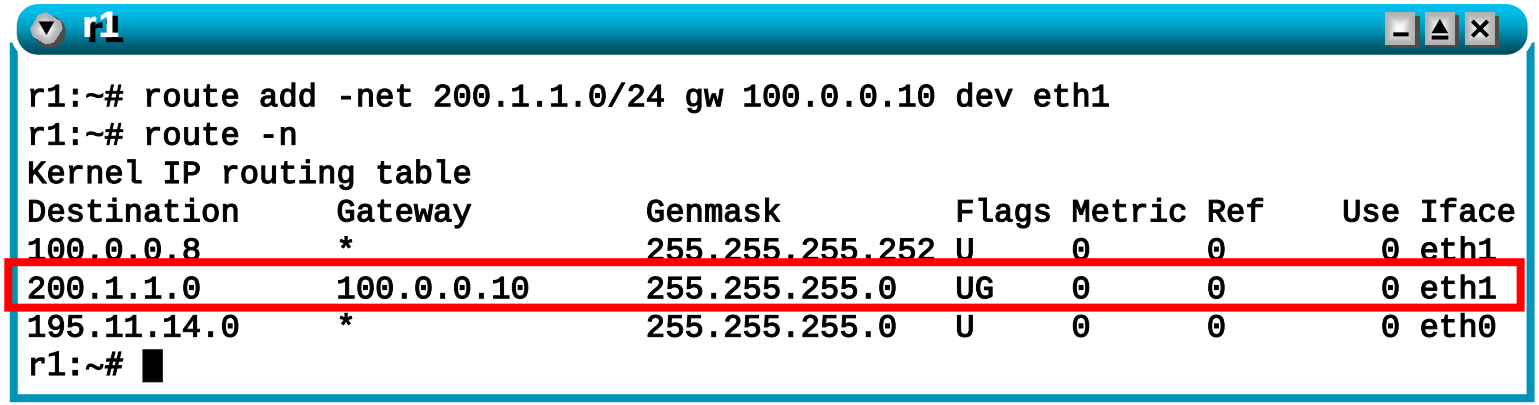


Step 5 – Configuring a static route



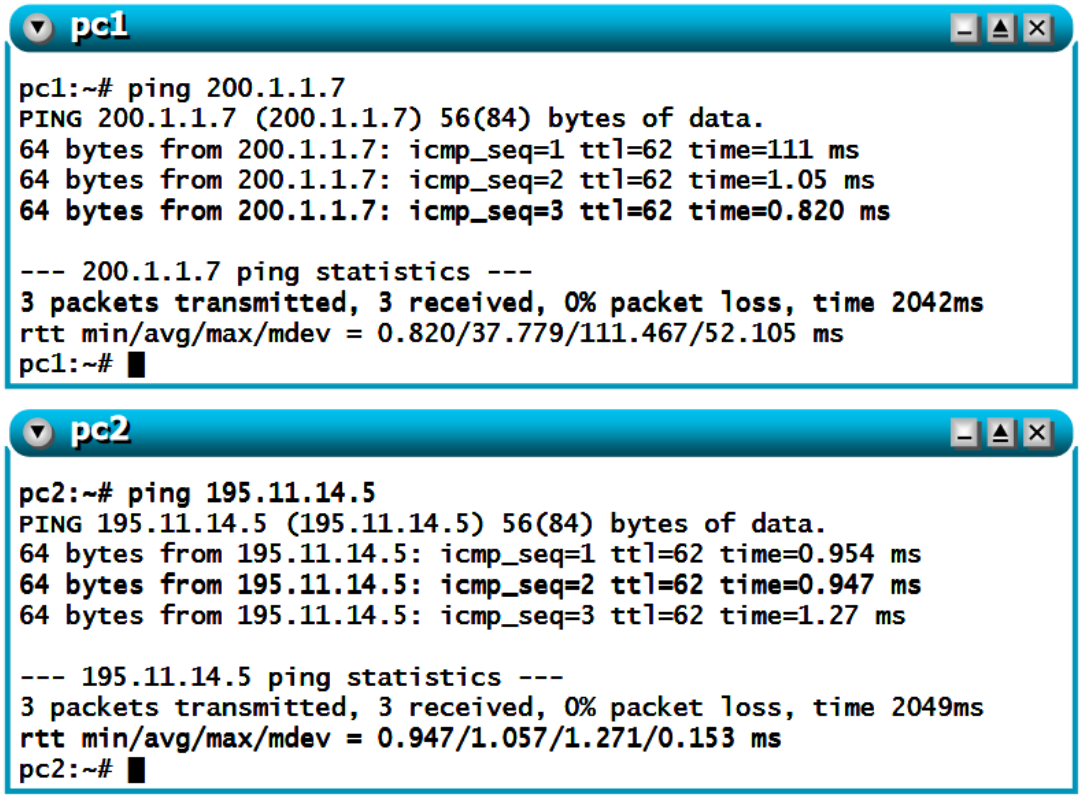
Step 5 – Configuring a static route

- A similar configuration should be deployed on **`r1`**



Step 5 – Testing static routes

- The PCs can now reach each other



Reporting

- Please deliver the following items to the UPEL system using your account
  1. A photocopy or a screenshot showing the output of the following commands:
     - **`route`** executed on router r<LAB-ID>
     - **`ping 200.1.1.7`** executed on pc1
     - **`ping 195.11.14.5`** executed on pc2

Obligatory exercises

- The default route can be statically configured by using

```
route add default gw 195.11.14.1 dev eth0
```

- Can you give a command to configure a static route that is equivalent to the default route?

```
route add -net __/__ gw __ dev __
```

Obligatory exercises

- Not all the routing tables contain a default route
- The network of this lab is so simple that routers **`r1`** and **`r2`** can be also configured to **exclusively** use default routes
- Try such a configuration and test it