Università degli Studi Roma Tre
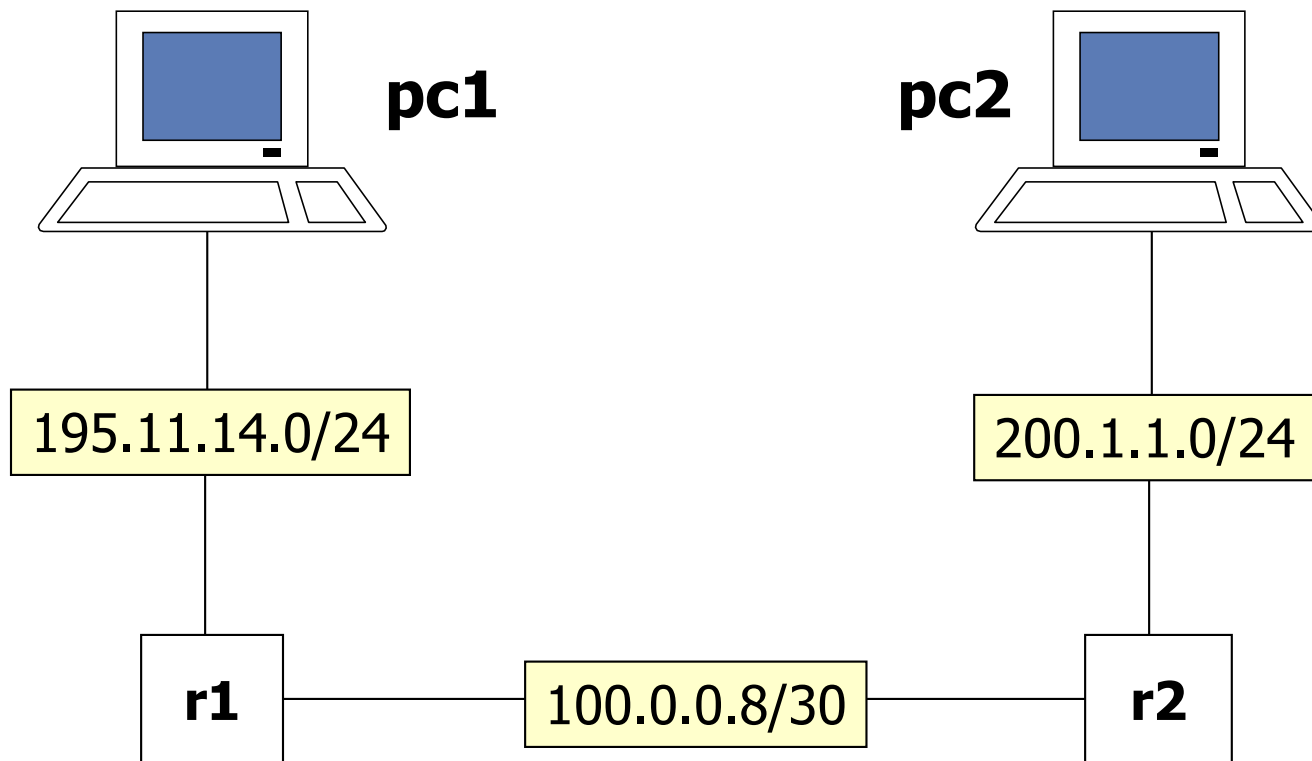Dipartimento di Ingegneria
Computer Networks Research Group

kathara lab

static-routing

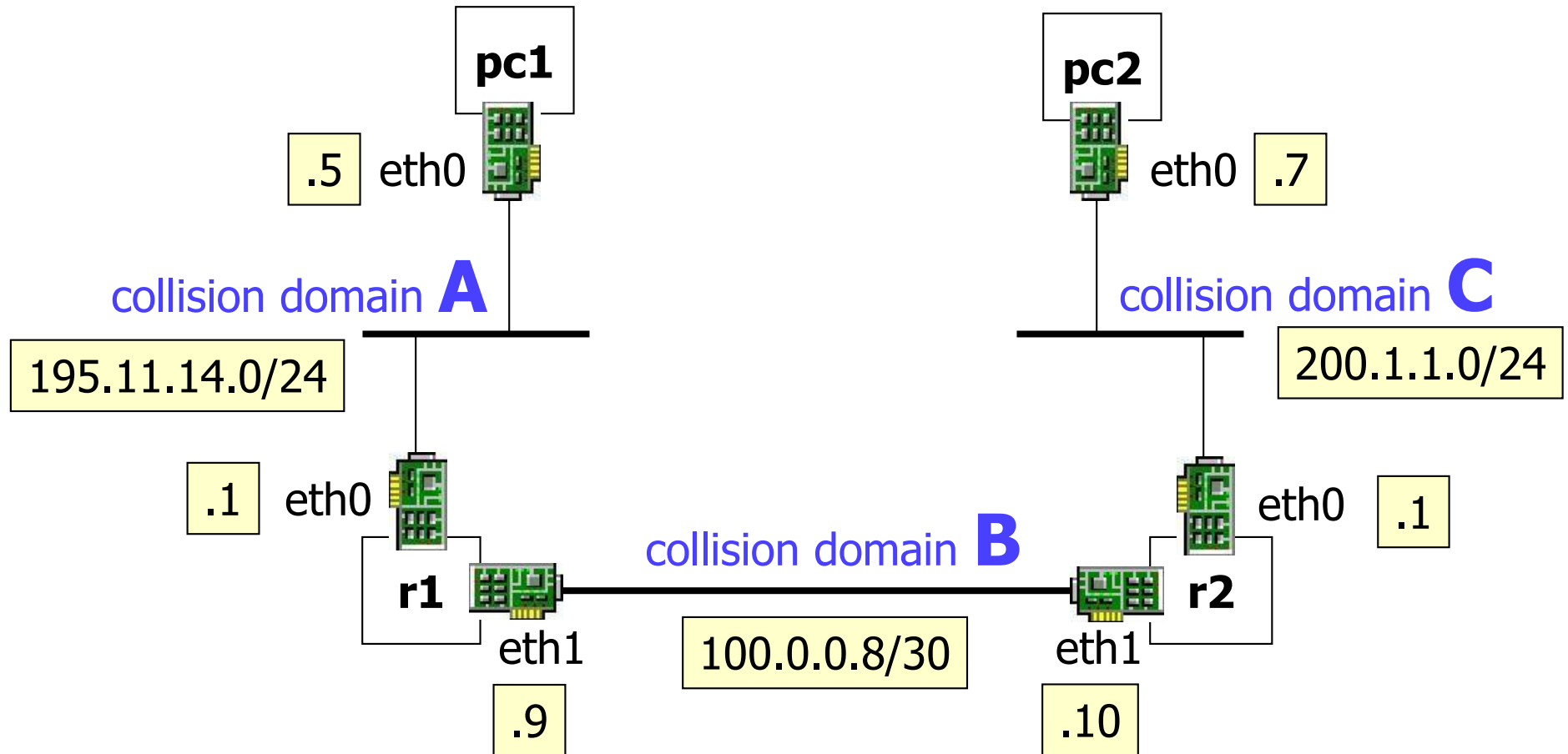| Version	1.0
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Web	http://www.kathara.org/
Description	an example of configuration of static routes – kathara version of netkit lab static-routing vers. 2.2

copyright notice

step 1 – network topology
high level view

pc1

pc2

195.11.14.0/24

200.1.1.0/24

r1

100.0.0.8/30

r2

step 1 – network topology configuration details

collision domain **A**

collision domain **B**

collision domain **C**

pc1 — .5 eth0

pc2 — eth0 .7

195.11.14.0/24

200.1.1.0/24

r1 — .1 eth0 — eth1 .9

100.0.0.8/30

r2 — eth0 .1 — eth1 .10

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step 2 – the lab

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

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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 netmask 255.255.255.0 broadcast 195.11.14.255 up
#route add default gw 195.11.14.1 dev eth0
```

the routing table entries
will be added manually

pc2.startup

```
ifconfig eth0 200.1.1.7 netmask 255.255.255.0 broadcast 200.1.1.255 up
#route add default gw 200.1.1.1 dev eth0
```

step 2 – the lab

r1.startup

```
ifconfig eth0 195.11.14.1 netmask 255.255.255.0 broadcast 195.11.14.255 up
ifconfig eth1 100.0.0.9 netmask 255.255.255.252 broadcast 100.0.0.11 up
#route add -net 200.1.1.0 netmask 255.255.255.0 gw 100.0.0.10 dev eth1
```

r2.startup

```
ifconfig eth0 200.1.1.1 netmask 255.255.255.0 broadcast 200.1.1.255 up
ifconfig eth1 100.0.0.10 netmask 255.255.255.252 broadcast 100.0.0.11 up
#route add -net 195.11.14.0 netmask 255.255.255.0 gw 100.0.0.9 dev eth1
```

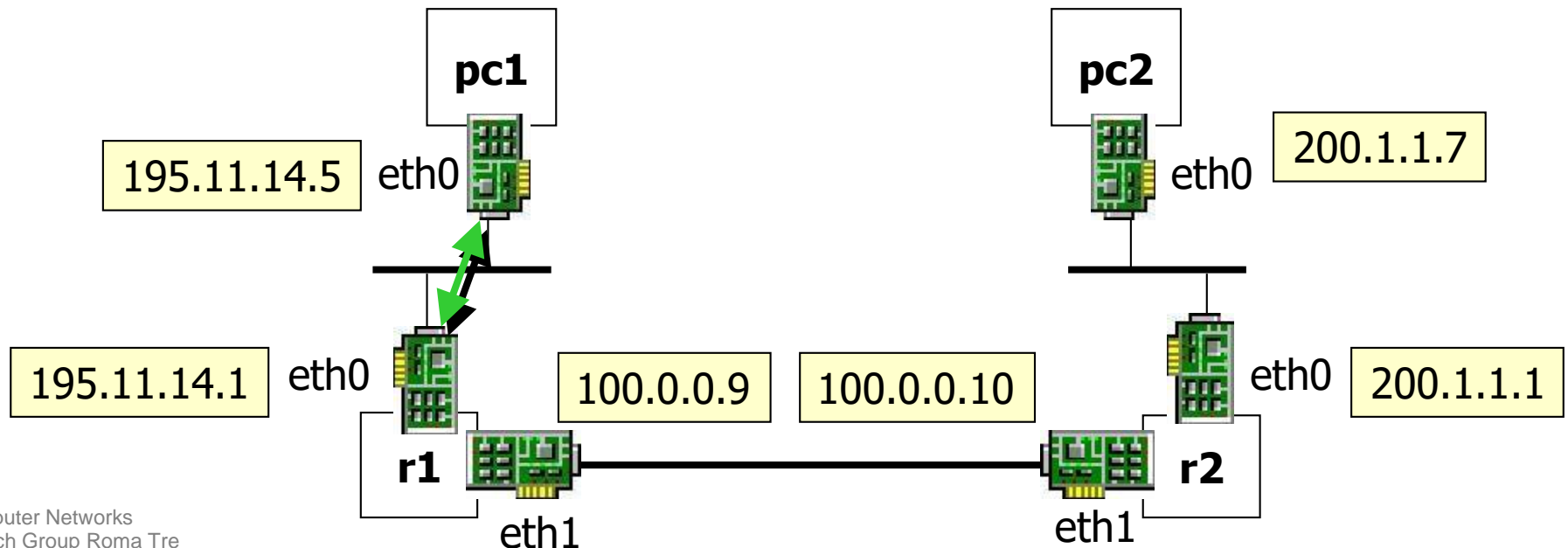the routing table entries
will be added manually

step 3 – testing connectivity

```
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
64 bytes from 195.11.14.1: icmp_seq=3 ttl=64 time=0.308 ms

--- 195.11.14.1 ping statistics ---
3 packets transmitted, 3 received, 0% packet loss, time 2019ms
rtt min/avg/max/mdev = 0.308/1.285/3.176/1.337 ms
pc1:~# █
```
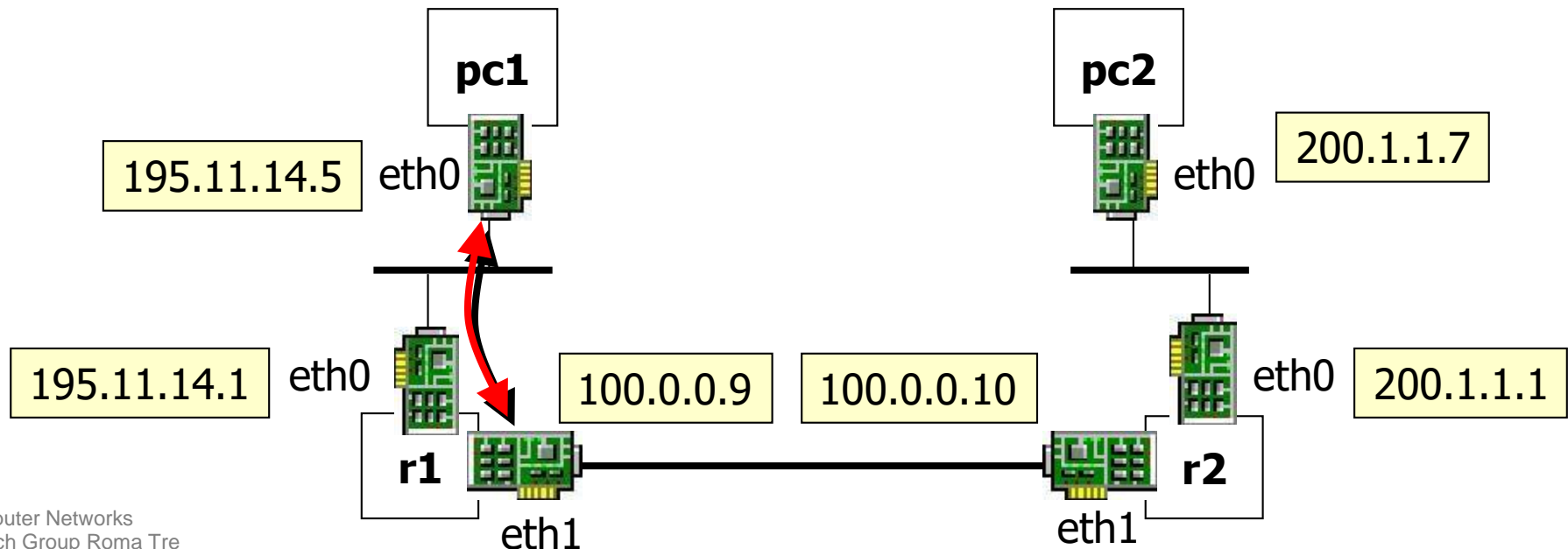
interfaces on the same domain can reach each other

pc1

pc2

195.11.14.5 eth0

200.1.1.7
eth0

195.11.14.1 eth0

100.0.0.9

100.0.0.10

eth0 200.1.1.1

r1 eth1

eth1 r2

step 3 – testing connectivity

```
pc1                                    _ ▲ ✕
pc1:~# ping 100.0.0.9
connect: Network is unreachable
pc1:~# █
```

interfaces on different domains cannot be reached

can you tell why?

pc1

195.11.14.5 eth0

pc2

200.1.1.7 eth0

195.11.14.1 eth0

100.0.0.9   100.0.0.10

eth0 200.1.1.1

r1 eth1

r2 eth1

step 3 – inspecting routing tables

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

```
pc1

pc1:~# route
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
pc1:~# █
```

```
r1

r1:~# route
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
r1:~# █
```

- 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!)

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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"

```
pc1:~# route add default gw 195.11.14.1
pc1:~# route
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
pc1:~# ▮
```

```
pc2:~# route add default gw 200.1.1.1
pc2:~# route
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
pc2:~# ▮
```
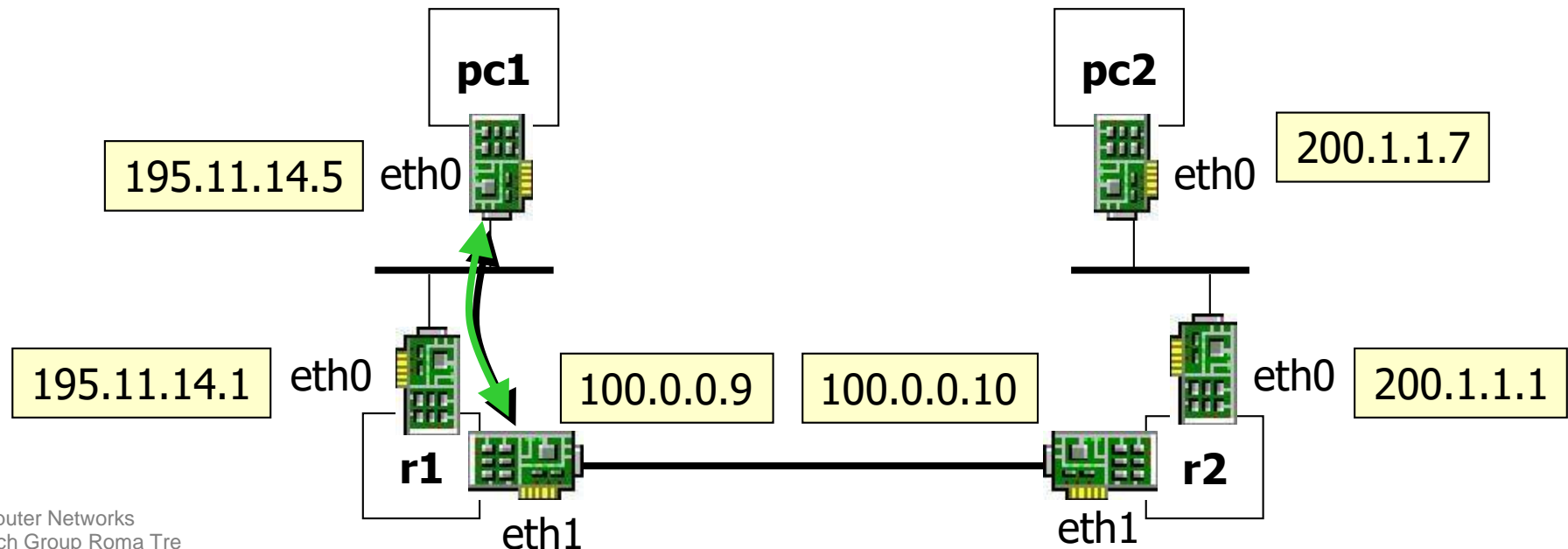
step 4 – default routes on pcs: test

step 4 – default routes on pcs: test

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`

```
r2:~# tcpdump -i eth1
tcpdump: verbose output suppressed, use -v or -vv for full protocol decode
listening on eth1, link-type EN10MB (Ethernet), capture size 96 bytes
16:06:58.977851 arp who-has 100.0.0.10 tell 100.0.0.9
16:06:59.088906 arp reply 100.0.0.10 is-at fe:fd:64:00:00:0a
16:06:59.089990 IP 195.11.14.5 > 100.0.0.10: icmp 64: echo request seq 1
16:06:59.989368 IP 195.11.14.5 > 100.0.0.10: icmp 64: echo request seq 2
16:07:01.001888 IP 195.11.14.5 > 100.0.0.10: icmp 64: echo request seq 3

5 packets captured
5 packets received by filter
0 packets dropped by kernel
r2:~# █
```

echo requests are arriving!

step 4 – r2's routing table

```
r2:~# route
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
200.1.1.0        *                255.255.255.0    U     0      0        0 eth0
r2:~# █
```

- **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**

```
r1:~# route add -net 200.1.1.0 netmask 255.255.255.0 gw 100.0.0.10 dev eth1
r1:~# route
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
200.1.1.0         100.0.0.10        255.255.255.0   UG    0      0        0 eth1
195.11.14.0       *                 255.255.255.0   U     0      0        0 eth0
r1:~# █
```

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step 5 – testing static routes

- the pcs can reach each other

pc1

```
pc1:~# ping 200.1.1.7
PING 200.1.1.7 (200.1.1.7) 56(84) bytes of data.
64 bytes from 200.1.1.7: icmp_seq=1 ttl=62 time=111 ms
64 bytes from 200.1.1.7: icmp_seq=2 ttl=62 time=1.05 ms
64 bytes from 200.1.1.7: icmp_seq=3 ttl=62 time=0.820 ms

--- 200.1.1.7 ping statistics ---
3 packets transmitted, 3 received, 0% packet loss, time 2042ms
rtt min/avg/max/mdev = 0.820/37.779/111.467/52.105 ms
pc1:~# █
```

pc2

```
pc2:~# ping 195.11.14.5
PING 195.11.14.5 (195.11.14.5) 56(84) bytes of data.
64 bytes from 195.11.14.5: icmp_seq=1 ttl=62 time=0.954 ms
64 bytes from 195.11.14.5: icmp_seq=2 ttl=62 time=0.947 ms
64 bytes from 195.11.14.5: icmp_seq=3 ttl=62 time=1.27 ms

--- 195.11.14.5 ping statistics ---
3 packets transmitted, 3 received, 0% packet loss, time 2049ms
rtt min/avg/max/mdev = 0.947/1.057/1.271/0.153 ms
pc2:~# █
```

proposed 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 __ netmask __ gw __ dev __

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proposed 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