

kathara lab

static-routing

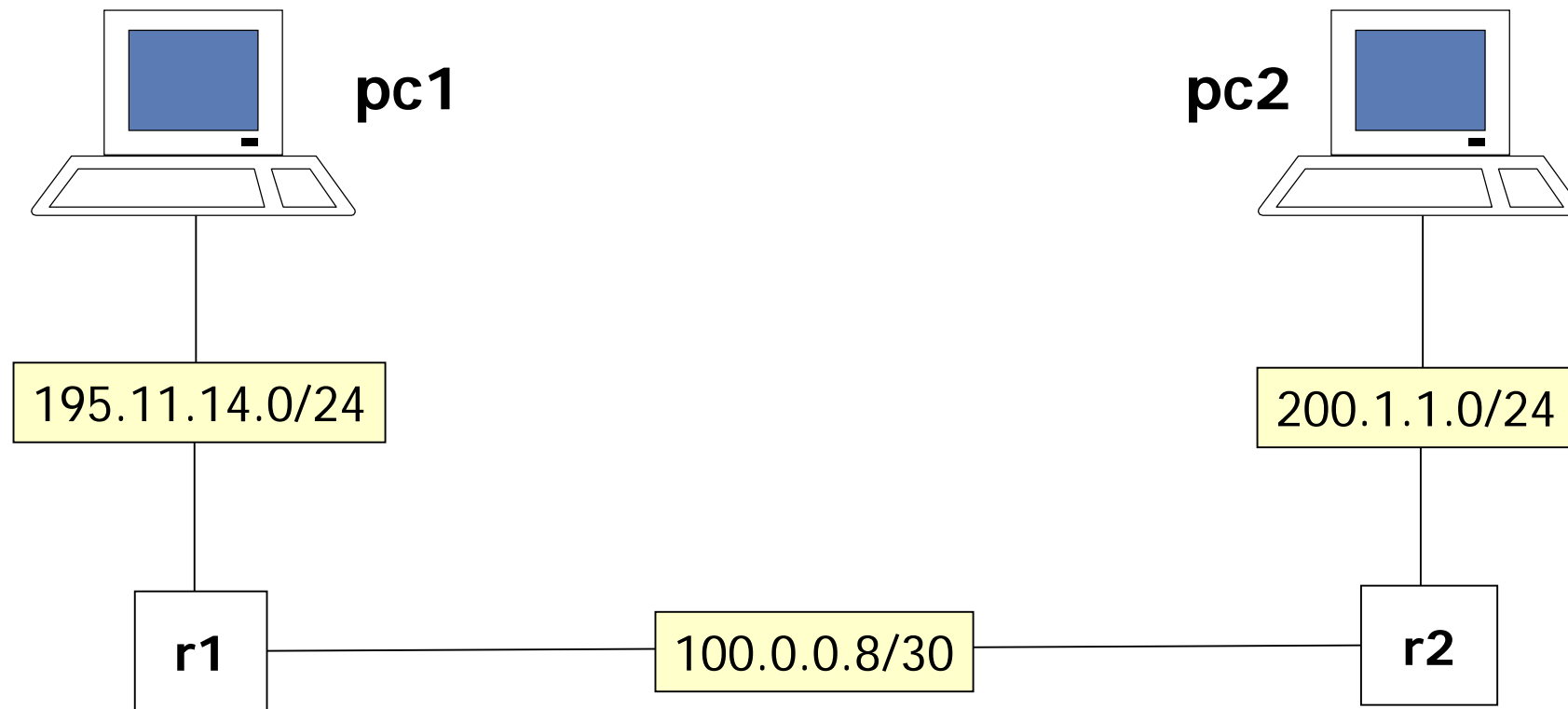
Version	1.0
Author(s)	G. Di Battista, M. Patrignani, M. Pizzonia, F. Ricci, M. Rimondini
E-mail	contact@kathara.org
Web	http://www.kathara.org/
Description	an example of configuration of static routes – kathara version of netkit lab static-routing vers. 2.2

Copyright notice

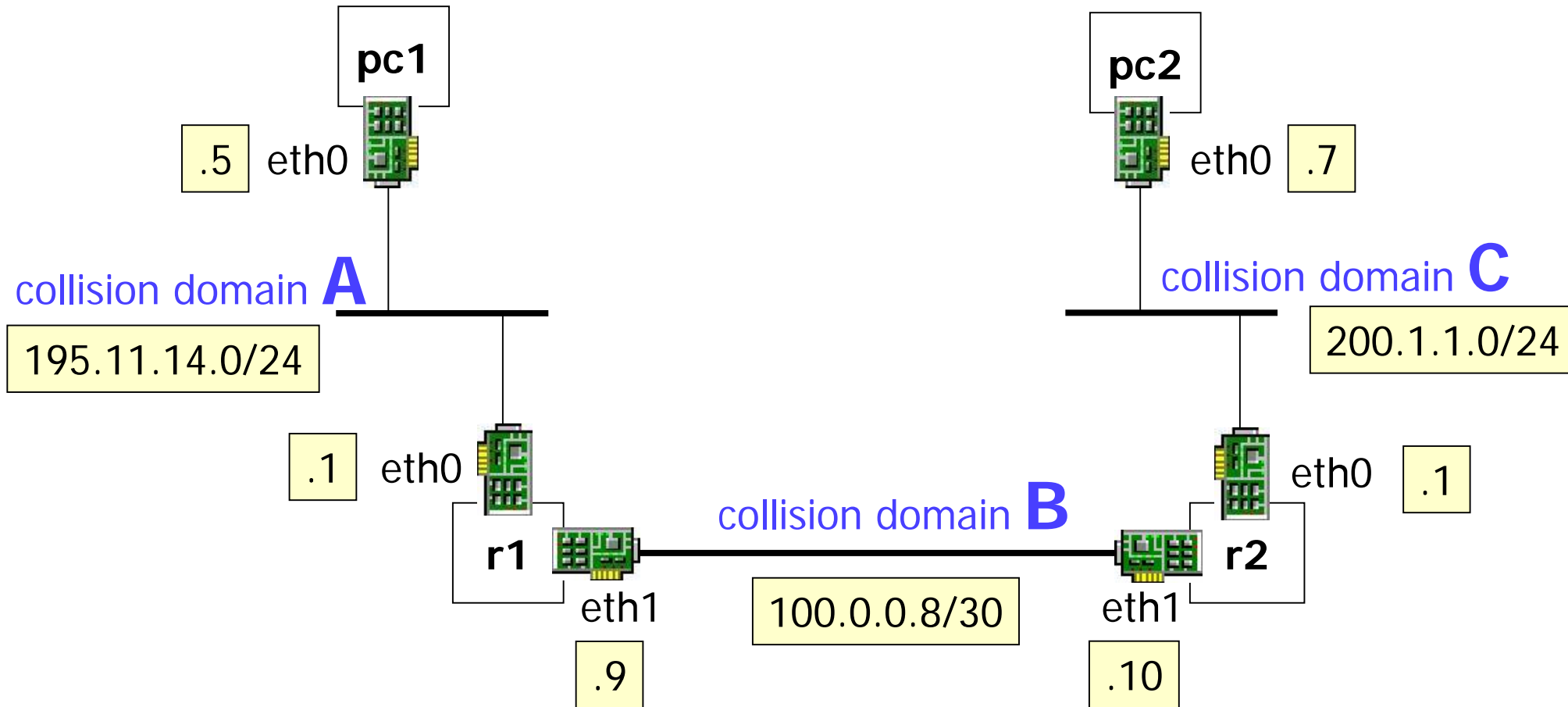
- All the pages/slides in this presentation, including but not limited to, images, photos, animations, videos, sounds, music, and text (hereby referred to as “material”) are protected by copyright.
- This material, with the exception of some multimedia elements licensed by other organizations, is property of the authors and/or organizations appearing in the first slide.
- This material, or its parts, can be reproduced and used for didactical purposes within universities and schools, provided that this happens for non-profit purposes.
- Information contained in this material cannot be used within network design projects or other products of any kind.
- Any other use is prohibited, unless explicitly authorized by the authors on the basis of an explicit agreement.
- The authors assume no responsibility about this material and provide this material “as is”, with no implicit or explicit warranty about the correctness and completeness of its contents, which may be subject to changes.
- This copyright notice must always be redistributed together with the material, or its portions.

step 1 – network topology

high level view



step 1 – network topology configuration details



step 2 – the lab

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

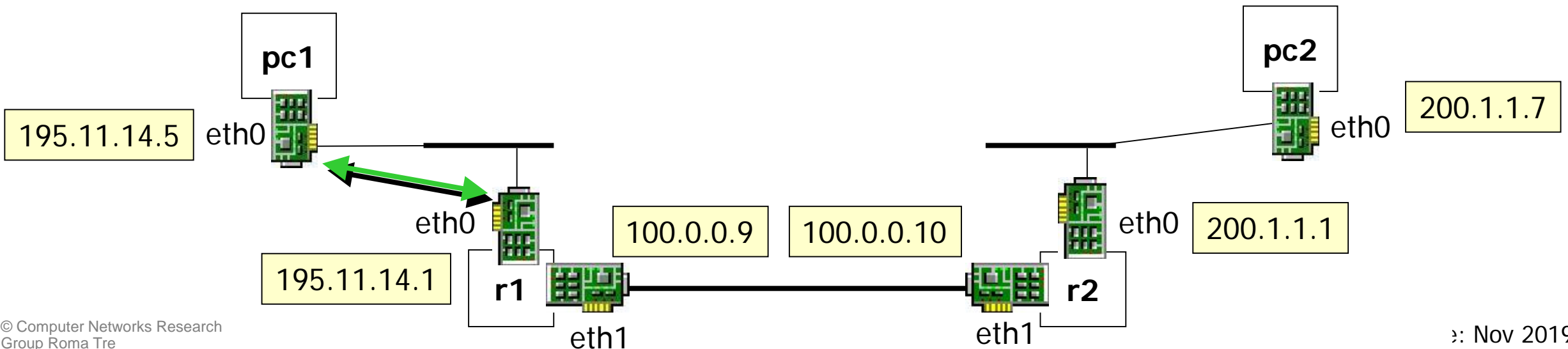
the routing table entries
will be added manually

step 3 – testing connectivity

```
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=3.176 ms
64 bytes from 195.11.14.1: icmp_seq=2 ttl=64 time=0.308 ms

--- 195.11.14.1 ping statistics ---
2 packets transmitted, 2 received, 0% packet loss, time 0.616 ms
rtt min/avg/max/mdev = 0.308/1.285/3.176/1.337 ms
```

interfaces on the same domain can reach each other

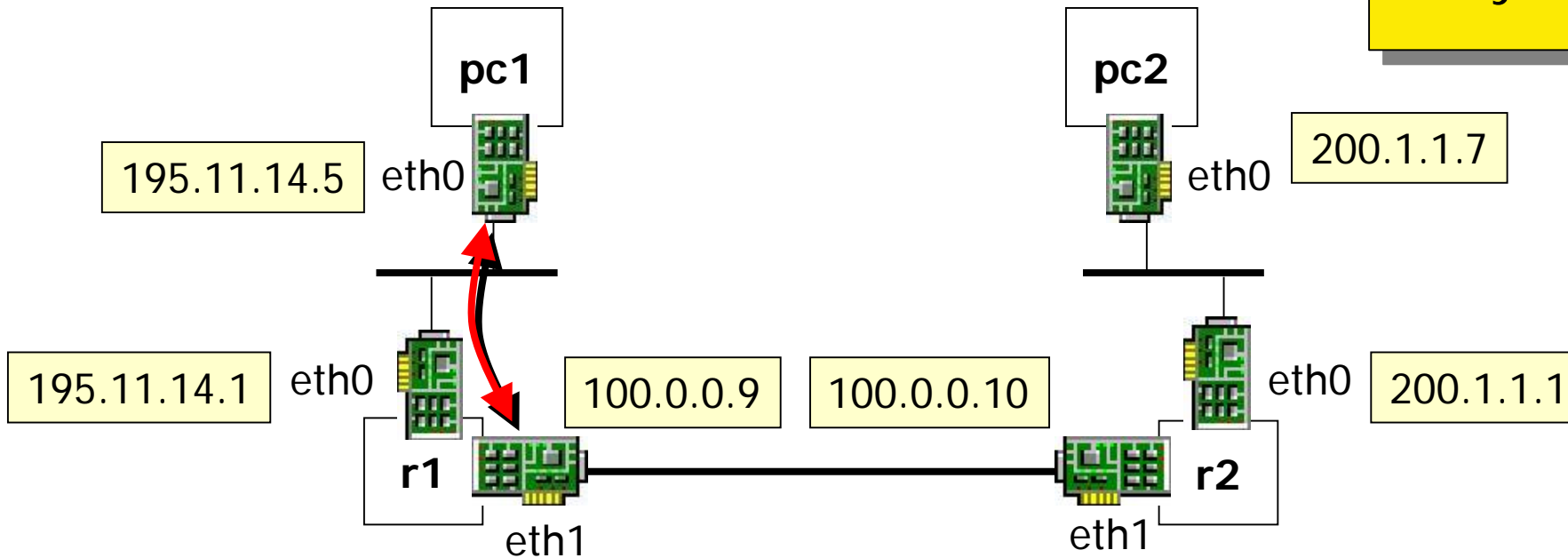


step 3 – testing connectivity

```
pc1
pc1: ~# ping 100.0.0.9
connect: Network is unreachable
pc1: ~#
```

interfaces on different domains cannot be reached

can you tell why?



step 3 – inspecting routing tables

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

```
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!)

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”

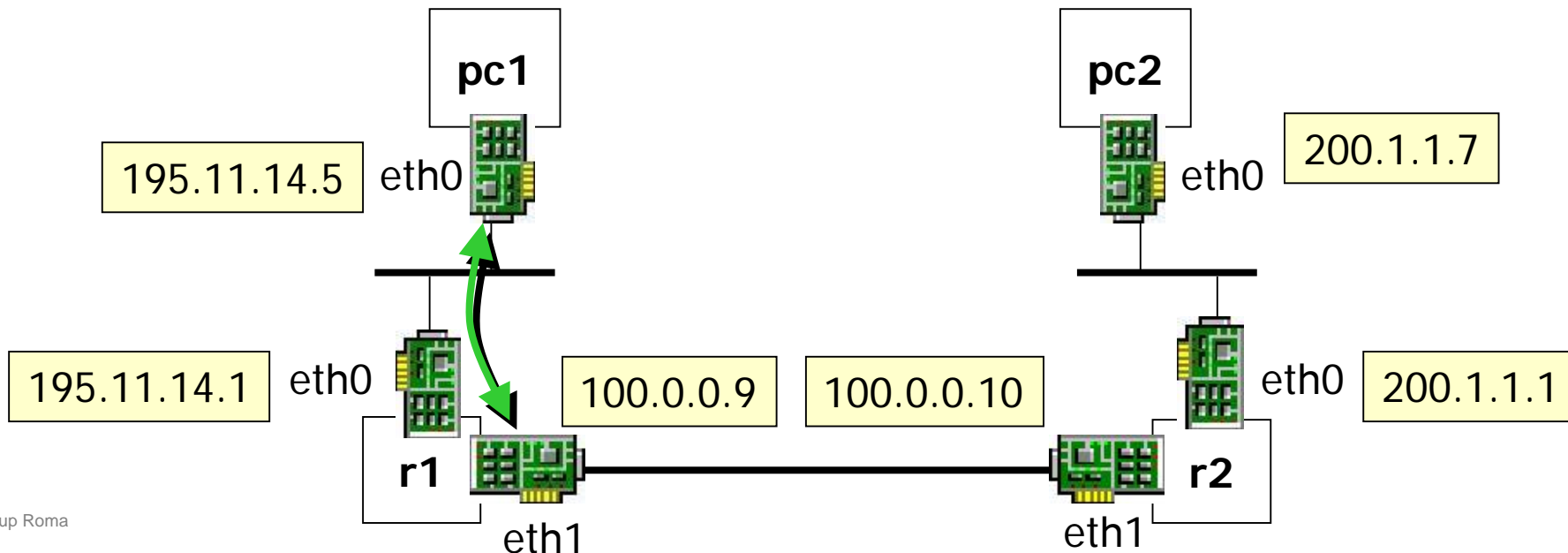
```
pc1:~# route add default gw 195.11.14.1
pc1:~# route
Kernel IP routing table
Destination      Gateway          Genmask          Flags Metric Ref    Use Iface
195.11.14.0      *                255.255.255.0    U      0      0      0 eth0
default          195.11.14.1     0.0.0.0          UG     0 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

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



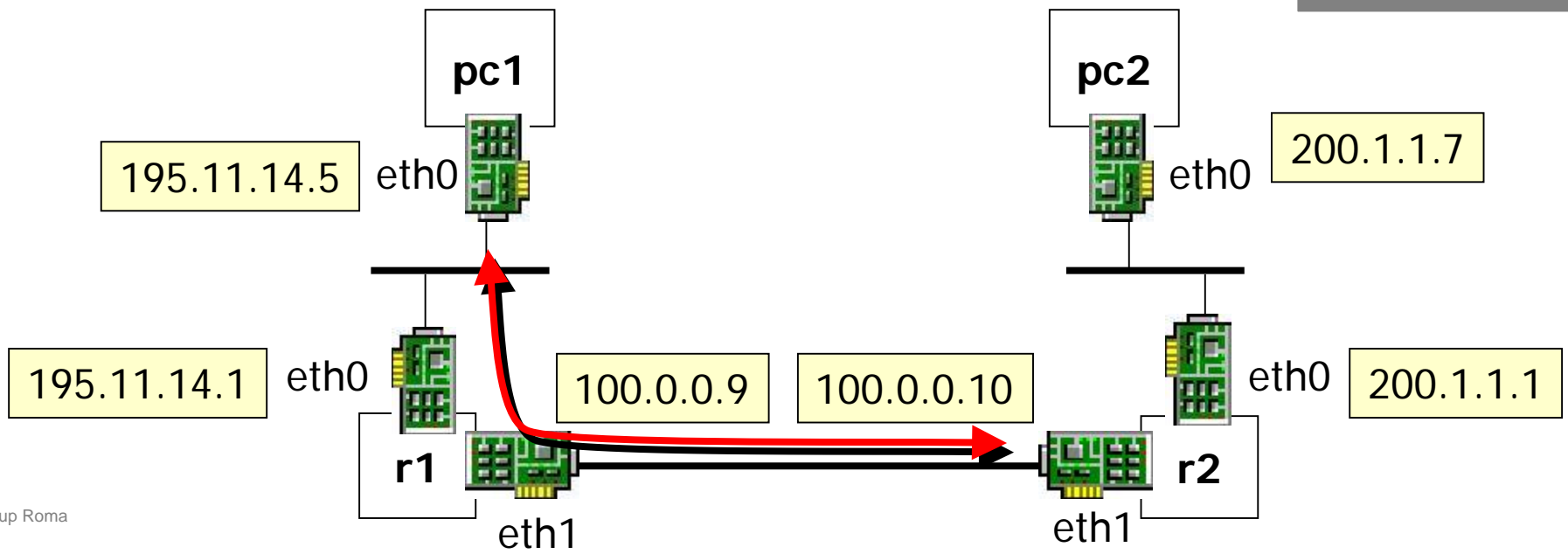
step 4 – default routes on pcs: test

```
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**

```
r2:~# tcpdump -tenni 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

- **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**

```
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:~# █
```

step 5 – configuring a static route

```
r2: ~# route add -net 195.11.14.0 netmask 255.255.255.0 gw 100.0.0.9 dev eth1
```

network 195.11.14.0...

...with netmask 255.255.255.0...

...is reachable via 100.0.0.9...

...on interface eth1

```
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
195.11.14.0      100.0.0.9       255.255.255.0  UG        0      0      0 eth1
r2: ~#
```


step 5 – configuring a static route

- a similar configuration should be deployed on **r1**

```
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:~# █
```

step 5 – testing static routes

- the PCs can now reach each other

```
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:~# █
```

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 ___
```

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