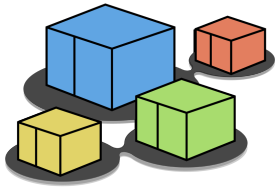
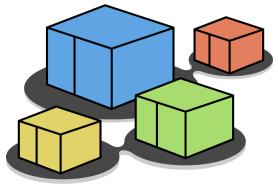


Kathará

kathara lab

static-routing

Version	1.2
Author(s)	L. Ariemma, G. Di Battista, M. Patrignani, M. Pizzonia, F. Ricci, M. Rimondini
E-mail	contact@kathara.org
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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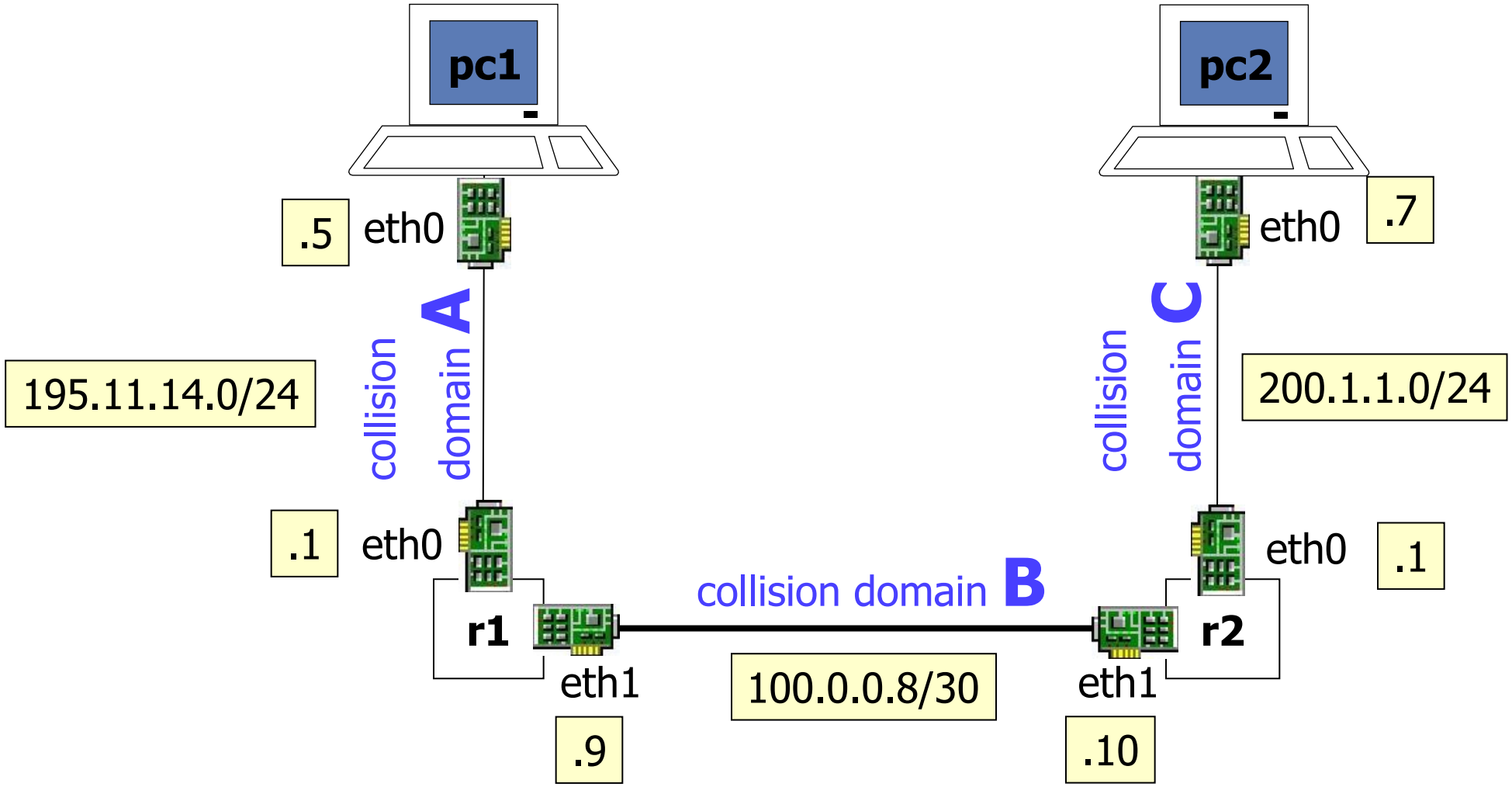
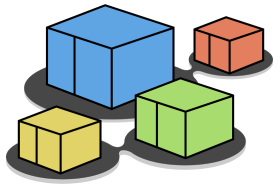
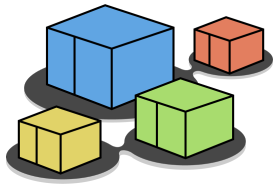
Step 1 – Network topology





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

```
ip address add 195.11.14.5/24 dev eth0
```

r1.startup

```
ip address add 195.11.14.1/24 dev eth0
ip address add 100.0.0.9/30 dev eth1
```

pc2.startup

```
ip address add 200.1.1.7/24 dev eth0
```

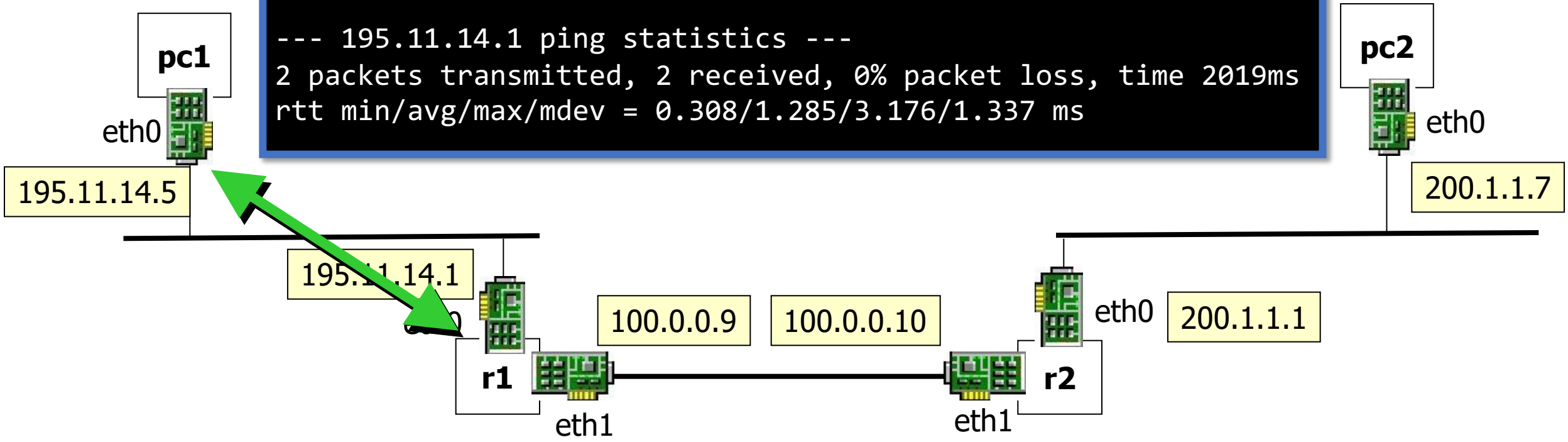
r2.startup

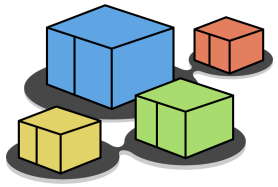
```
ip address add 200.1.1.1/24 dev eth0
ip address add 100.0.0.10/30 dev eth1
```

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=3.17 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
```



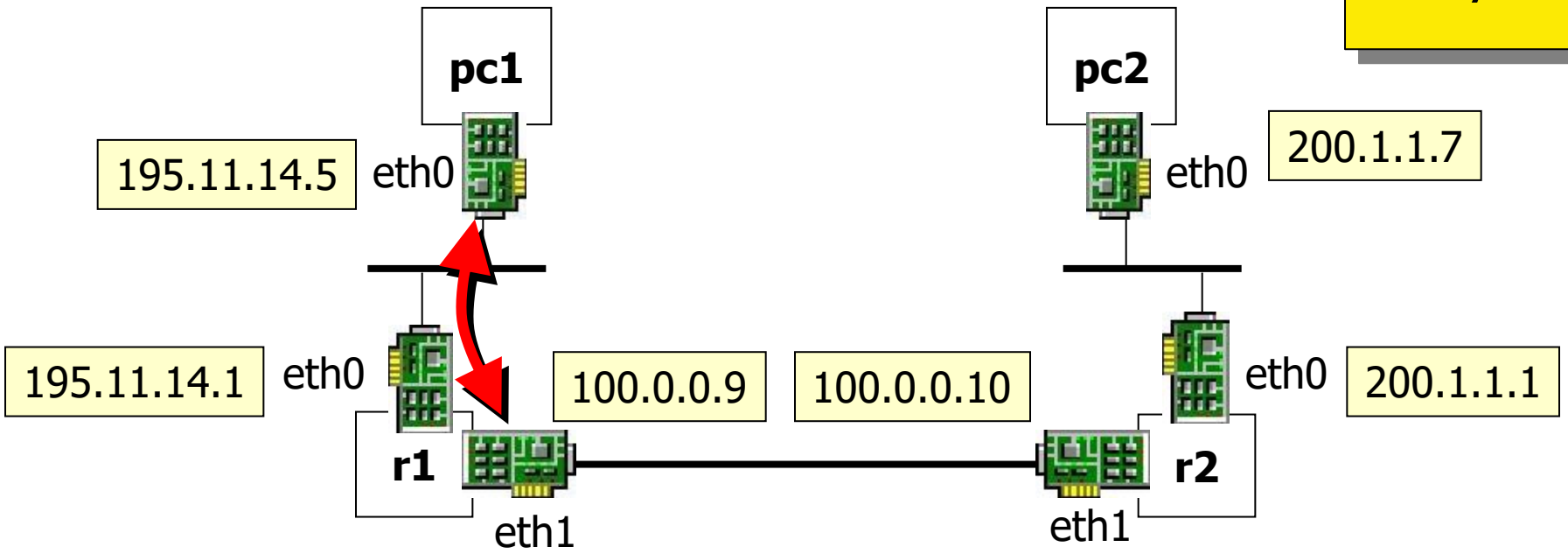


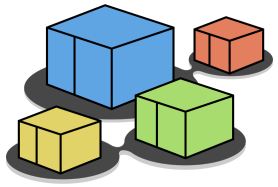
Step 3 – Testing connectivity

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

interfaces on different domains cannot be reached

can you tell why?



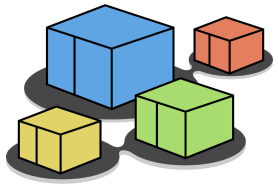


Step 3 – Inspecting routing tables

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

```
root@pc1:~$ ip route
100.0.0.8/30 dev eth1 proto kernel scope link src 100.0.0.9
195.11.14.0/24 dev eth0 proto kernel scope link src 195.11.14.1
```

- 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”

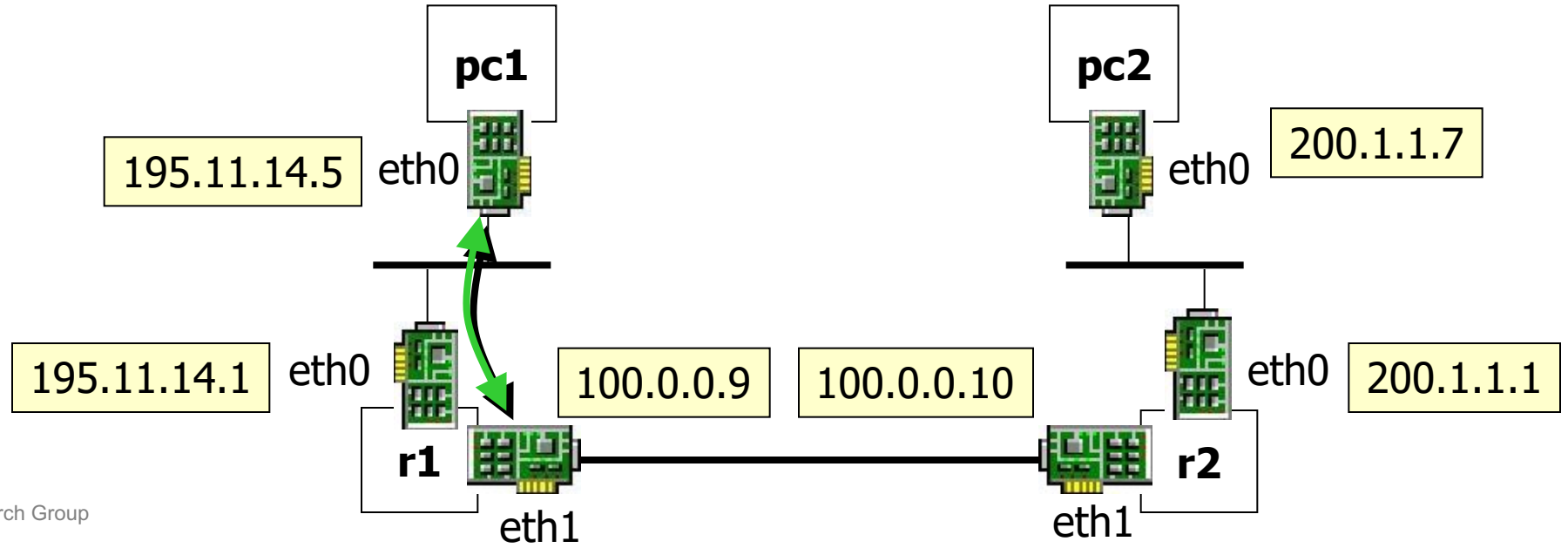
```
root@pc1:~$ ip route add default via 195.11.14.1 dev eth0
root@pc1:~$ ip route
default via 195.11.14.1 dev eth0
195.11.14.0/24 dev eth0 proto kernel scope link src 195.11.14.5
```

Step 4 – Default routes on PCs: test

```
root@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
```

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



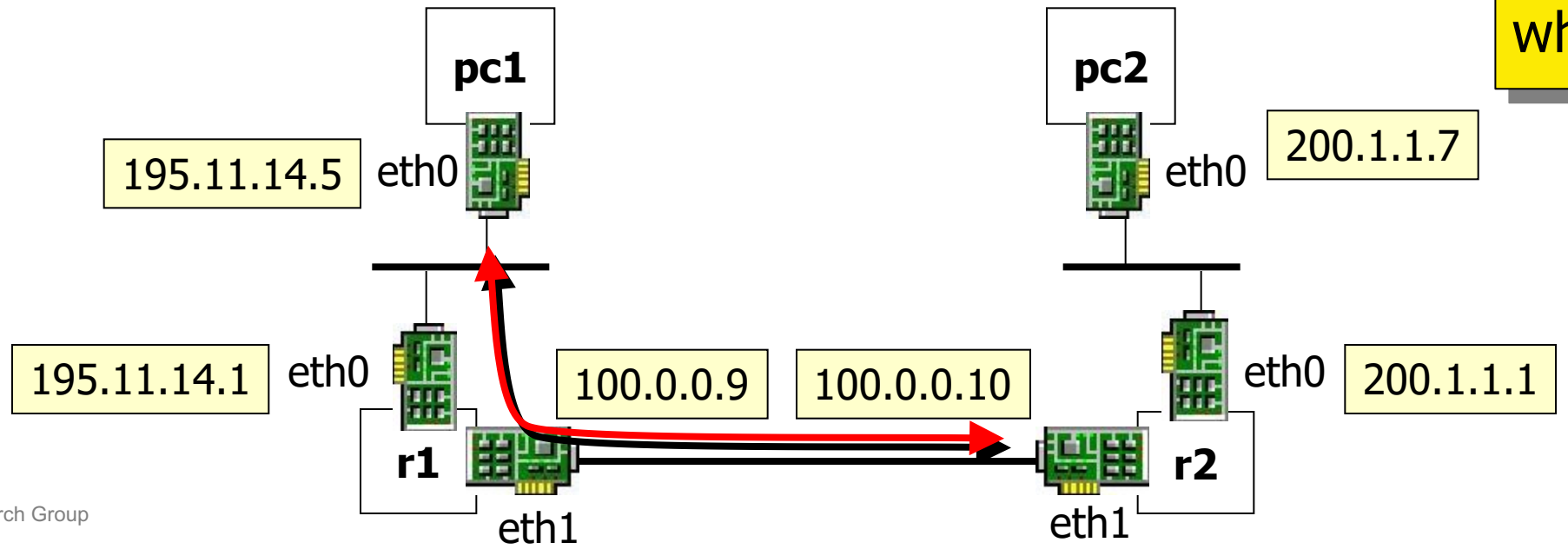
Step 4 – Default routes on PCs: test

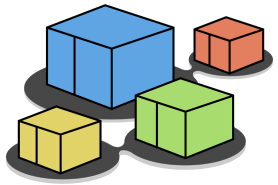
```
root@pc1:~$ ping 100.0.0.9
PING 100.0.0.10 (100.0.0.10) 56(84) bytes of data.

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

interfaces on **r2** seem unreachable!

can you tell why?





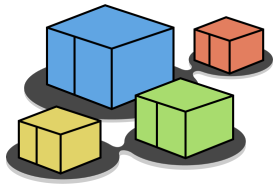
Step 4 – Let's inspect the network

- Do echo request packets reach **`r2`**?
- Let's check while pinging from **`pc1`**, sniff interface eth1 of **`r2`**

```
root@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
```

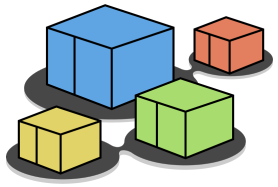
echo requests are arriving!



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**

```
root@r2:~$ ip route
100.0.0.8/30 dev eth1 proto kernel scope link src 100.0.0.10
200.1.1.0/24 dev eth0 proto kernel scope link src 200.1.1.1
```



Step 5 – Configuring a static route

```
root@r2:~$ ip route add 195.11.14.0/24 via 100.0.0.9 dev eth1
```

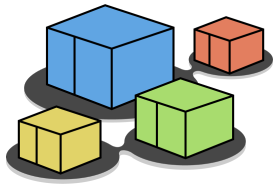
network 195.11.14.0...

...with netmask 24...

...is reachable via 100.0.0.9...

...on interface eth1

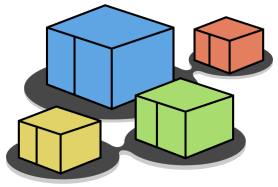
```
root@r2:~$ ip route
100.0.0.8/30 dev eth1 proto kernel scope link src 100.0.0.10
195.11.14.0/24 via 100.0.0.9 dev eth1
200.1.1.0/24 dev eth0 proto kernel scope link src 200.1.1.1
```



Step 5 – Configuring a static route

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

```
root@r1:~$ ip route add 200.1.1.0/24 via 100.0.0.10 dev eth1
root@r1:~$ ip route
100.0.0.8/30 dev eth1 proto kernel scope link src 100.0.0.9
195.11.14.0/24 dev eth0 proto kernel scope link src 195.11.14.1
200.1.1.0/24 via 100.0.0.10 dev eth1
```

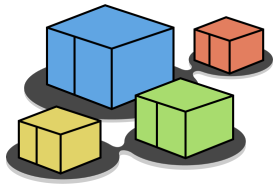


Step 5 – Testing static routes

- The PCs can now reach each other

```
root@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
```



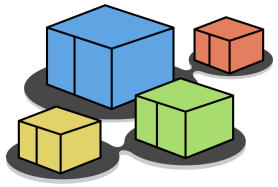
Proposed exercises

- The default route can be statically configured by using

```
ip route add default via 195.11.14.1 dev eth0
```

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

```
ip route add __/__ via __ 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