

Sieci komputerowe – Warsztaty 4

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Zadanie dopuszczające do dalszych części (0 pkt.)

Najpierw ustawiamy nazwy interfejsów

```
V1#> ip link set enp0s3 name enp-all
V1#> ip link set enp0s8 name enp-rem1
V1#> ip link set enp0s9 name enp-rem4

V2#> ip link set enp0s3 name enp-all
V2#> ip link set enp0s8 name enp-rem1
V2#> ip link set enp0s9 name enp-rem2

V3#> ip link set enp0s3 name enp-all
V3#> ip link set enp0s8 name enp-rem2
V3#> ip link set enp0s9 name enp-rem3

V4#> ip link set enp0s3 name enp-all
V4#> ip link set enp0s8 name enp-rem3
V4#> ip link set enp0s9 name enp-rem4
```

Aktywujemy interfejsy sieciowe i przypisujemy im adresy IP

```
V1#> ip link set up dev enp-rem1
V1#> ip addr add 192.168.1.1/24 dev enp-rem1
V1#> ip link set up dev enp-rem4
V1#> ip addr add 192.168.4.1/24 dev enp-rem4

V2#> ip link set up dev enp-rem1
V2#> ip addr add 192.168.1.2/24 dev enp-rem1
V2#> ip link set up dev enp-rem2
V2#> ip addr add 192.168.2.2/24 dev enp-rem2

V3#> ip link set up dev enp-rem2
V3#> ip addr add 192.168.2.3/24 dev enp-rem2
V3#> ip link set up dev enp-rem3
V3#> ip addr add 192.168.3.3/24 dev enp-rem3

V4#> ip link set up dev enp-rem3
V4#> ip addr add 192.168.3.4/24 dev enp-rem3
V4#> ip link set up dev enp-rem4
V4#> ip addr add 192.168.4.4/24 dev enp-rem4
```

Otrzymujemy następujące tablice routingu:

```
Virbian1 [Running] - Oracle VM VirtualBox
File Machine View Input Devices Help
root@virbian: /home/user
root@virbian:/home/user# ip route
192.168.1.0/24 dev enp-rem1 proto kernel scope link src 192.168.1.1
192.168.4.0/24 dev enp-rem4 proto kernel scope link src 192.168.4.1
root@virbian:/home/user#

Virbian2 [Running] - Oracle VM VirtualBox
File Machine View Input Devices Help
root@virbian: /home/user
root@virbian:/home/user# ip route
192.168.1.0/24 dev enp-rem1 proto kernel scope link src 192.168.1.2
192.168.2.0/24 dev enp-rem2 proto kernel scope link src 192.168.2.2
root@virbian:/home/user#

Virbian3 [Running] - Oracle VM VirtualBox
File Machine View Input Devices Help
root@virbian: /home/user
root@virbian:/home/user# ip route
192.168.2.0/24 dev enp-rem2 proto kernel scope link src 192.168.2.3
192.168.3.0/24 dev enp-rem3 proto kernel scope link src 192.168.3.3
root@virbian:/home/user#

Virbian4 [Running] - Oracle VM VirtualBox
File Machine View Input Devices Help
root@virbian: /home/user
root@virbian:/home/user# ip route
192.168.3.0/24 dev enp-rem3 proto kernel scope link src 192.168.3.4
192.168.4.0/24 dev enp-rem4 proto kernel scope link src 192.168.4.4
root@virbian:/home/user#
```

Za pomocą **ping** sprawdzamy, że wszystkie bezpośrednio połączone maszyny są osiągalne:

```
Virbian1 [Running] - Oracle VM VirtualBox
File Machine View Input Devices Help
root@virbian: /home/user
root@virbian:/home/user# ping 192.168.1.2
PING 192.168.1.2 (192.168.1.2) 56(84) bytes of data.
64 bytes from 192.168.1.2: icmp_seq=1 ttl=64 time=0.879 ms
64 bytes from 192.168.1.2: icmp_seq=2 ttl=64 time=0.881 ms
64 bytes from 192.168.1.2: icmp_seq=3 ttl=64 time=1.13 ms
^C
--- 192.168.1.2 ping statistics ---
3 packets transmitted, 3 received, 0% packet loss, time 5ms
rtt min/avg/max/mdev = 0.879/0.962/1.128/0.122 ms
root@virbian:/home/user# ping 192.168.4.4
PING 192.168.4.4 (192.168.4.4) 56(84) bytes of data.
64 bytes from 192.168.4.4: icmp_seq=1 ttl=64 time=1.31 ms
64 bytes from 192.168.4.4: icmp_seq=2 ttl=64 time=0.418 ms
64 bytes from 192.168.4.4: icmp_seq=3 ttl=64 time=0.799 ms
^C
--- 192.168.4.4 ping statistics ---
3 packets transmitted, 3 received, 0% packet loss, time 34ms
rtt min/avg/max/mdev = 0.418/0.843/1.312/0.366 ms
root@virbian:/home/user#
```

```
Virbian2 [Running] - Oracle VM VirtualBox
File Machine View Input Devices Help

root@virbian: /home/user

root@virbian:/home/user# ping 192.168.1.1
PING 192.168.1.1 (192.168.1.1) 56(84) bytes of data.
64 bytes from 192.168.1.1: icmp_seq=1 ttl=64 time=0.349 ms
64 bytes from 192.168.1.1: icmp_seq=2 ttl=64 time=0.327 ms
64 bytes from 192.168.1.1: icmp_seq=3 ttl=64 time=0.672 ms
^C
--- 192.168.1.1 ping statistics ---
3 packets transmitted, 3 received, 0% packet loss, time 56ms
rtt min/avg/max/mdev = 0.327/0.449/0.672/0.158 ms
root@virbian:/home/user# ping 192.168.2.3
PING 192.168.2.3 (192.168.2.3) 56(84) bytes of data.
64 bytes from 192.168.2.3: icmp_seq=1 ttl=64 time=0.554 ms
64 bytes from 192.168.2.3: icmp_seq=2 ttl=64 time=0.355 ms
64 bytes from 192.168.2.3: icmp_seq=3 ttl=64 time=0.553 ms
^C
--- 192.168.2.3 ping statistics ---
3 packets transmitted, 3 received, 0% packet loss, time 43ms
rtt min/avg/max/mdev = 0.355/0.487/0.554/0.095 ms
root@virbian:/home/user#
```

```
Virbian3 [Running] - Oracle VM VirtualBox
File Machine View Input Devices Help

root@virbian: /home/user

root@virbian:/home/user# ping 192.168.2.2
PING 192.168.2.2 (192.168.2.2) 56(84) bytes of data.
64 bytes from 192.168.2.2: icmp_seq=1 ttl=64 time=0.438 ms
64 bytes from 192.168.2.2: icmp_seq=2 ttl=64 time=0.391 ms
64 bytes from 192.168.2.2: icmp_seq=3 ttl=64 time=0.650 ms
^C
--- 192.168.2.2 ping statistics ---
3 packets transmitted, 3 received, 0% packet loss, time 36ms
rtt min/avg/max/mdev = 0.391/0.493/0.650/0.112 ms
root@virbian:/home/user# ping 192.168.3.4
PING 192.168.3.4 (192.168.3.4) 56(84) bytes of data.
64 bytes from 192.168.3.4: icmp_seq=1 ttl=64 time=0.995 ms
64 bytes from 192.168.3.4: icmp_seq=2 ttl=64 time=0.558 ms
64 bytes from 192.168.3.4: icmp_seq=3 ttl=64 time=0.712 ms
^C
--- 192.168.3.4 ping statistics ---
3 packets transmitted, 3 received, 0% packet loss, time 29ms
rtt min/avg/max/mdev = 0.558/0.755/0.995/0.180 ms
root@virbian:/home/user#
```

```
Virbian4 [Running] - Oracle VM VirtualBox
File Machine View Input Devices Help

root@virbian: /home/user

root@virbian:/home/user# ping 192.168.3.3
PING 192.168.3.3 (192.168.3.3) 56(84) bytes of data.
64 bytes from 192.168.3.3: icmp_seq=1 ttl=64 time=0.313 ms
64 bytes from 192.168.3.3: icmp_seq=2 ttl=64 time=0.769 ms
64 bytes from 192.168.3.3: icmp_seq=3 ttl=64 time=1.51 ms
^C
--- 192.168.3.3 ping statistics ---
3 packets transmitted, 3 received, 0% packet loss, time 32ms
rtt min/avg/max/mdev = 0.313/0.863/1.508/0.492 ms
root@virbian:/home/user# ping 192.168.4.1
PING 192.168.4.1 (192.168.4.1) 56(84) bytes of data.
64 bytes from 192.168.4.1: icmp_seq=1 ttl=64 time=0.474 ms
64 bytes from 192.168.4.1: icmp_seq=2 ttl=64 time=0.454 ms
64 bytes from 192.168.4.1: icmp_seq=3 ttl=64 time=0.420 ms
^C
--- 192.168.4.1 ping statistics ---
3 packets transmitted, 3 received, 0% packet loss, time 62ms
rtt min/avg/max/mdev = 0.420/0.449/0.474/0.028 ms
root@virbian:/home/user#
```

Zadanie do zaprezentowania (5 pkt.)

Najpierw ustawiamy nazwy interfejsów

```
V1#> ip link set enp0s3 name enp0
V2#> ip link set enp0s3 name enp0
V3#> ip link set enp0s3 name enp0
V3#> ip link set enp0s8 name enp1
V4#> ip link set enp0s3 name enp-out
```

Uruchamiamy interfejsy i przypisujemy im adresy

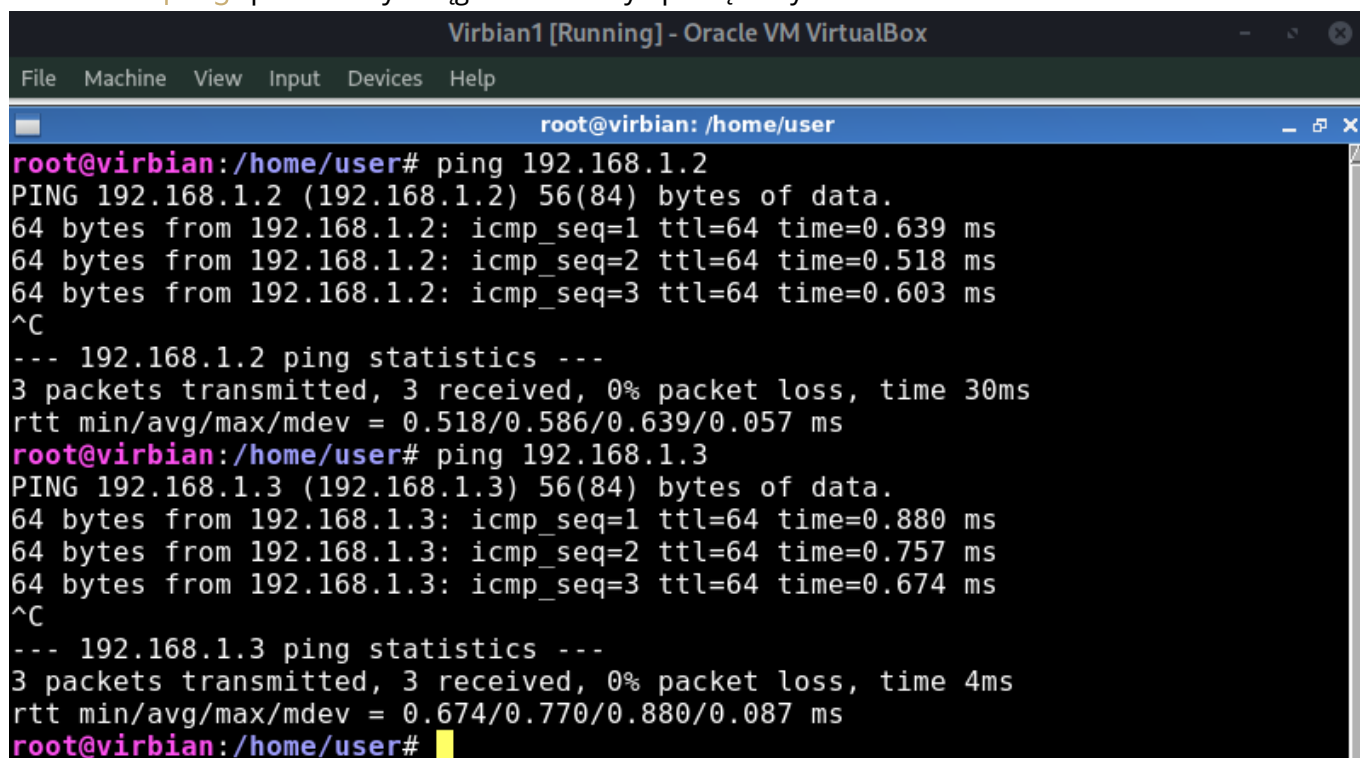
```
V1#> ip link set up dev enp0
V1#> ip addr add 192.168.1.1/24 dev enp0

V2#> ip link set up dev enp0
V2#> ip addr add 192.168.1.2/24 dev enp0

V3#> ip link set up dev enp0
V3#> ip addr add 192.168.1.3/24 dev enp0
V3#> ip link set up dev enp1
V3#> ip addr add 192.168.2.1/24 dev enp1

V4#> ip link set up dev enp-out
V4#> ip addr add 192.168.2.2/24 dev enp-out
```

Poleceniem **ping** sprawdzamy osiągalność maszyn podłączonych do sieci **local0**



```
Virbian1 [Running] - Oracle VM VirtualBox
File Machine View Input Devices Help
root@virbian: /home/user
root@virbian:/home/user# ping 192.168.1.2
PING 192.168.1.2 (192.168.1.2) 56(84) bytes of data.
64 bytes from 192.168.1.2: icmp_seq=1 ttl=64 time=0.639 ms
64 bytes from 192.168.1.2: icmp_seq=2 ttl=64 time=0.518 ms
64 bytes from 192.168.1.2: icmp_seq=3 ttl=64 time=0.603 ms
^C
--- 192.168.1.2 ping statistics ---
3 packets transmitted, 3 received, 0% packet loss, time 30ms
rtt min/avg/max/mdev = 0.518/0.586/0.639/0.057 ms
root@virbian:/home/user# ping 192.168.1.3
PING 192.168.1.3 (192.168.1.3) 56(84) bytes of data.
64 bytes from 192.168.1.3: icmp_seq=1 ttl=64 time=0.880 ms
64 bytes from 192.168.1.3: icmp_seq=2 ttl=64 time=0.757 ms
64 bytes from 192.168.1.3: icmp_seq=3 ttl=64 time=0.674 ms
^C
--- 192.168.1.3 ping statistics ---
3 packets transmitted, 3 received, 0% packet loss, time 4ms
rtt min/avg/max/mdev = 0.674/0.770/0.880/0.087 ms
root@virbian:/home/user#
```

```
Virbian2 [Running] - Oracle VM VirtualBox
File Machine View Input Devices Help

root@virbian: /home/user

root@virbian:/home/user# ping 192.168.1.1
PING 192.168.1.1 (192.168.1.1) 56(84) bytes of data.
64 bytes from 192.168.1.1: icmp_seq=1 ttl=64 time=0.684 ms
64 bytes from 192.168.1.1: icmp_seq=2 ttl=64 time=0.750 ms
64 bytes from 192.168.1.1: icmp_seq=3 ttl=64 time=0.692 ms
^C
--- 192.168.1.1 ping statistics ---
3 packets transmitted, 3 received, 0% packet loss, time 4ms
rtt min/avg/max/mdev = 0.684/0.708/0.750/0.042 ms
root@virbian:/home/user# ping 192.168.1.3
PING 192.168.1.3 (192.168.1.3) 56(84) bytes of data.
64 bytes from 192.168.1.3: icmp_seq=1 ttl=64 time=0.938 ms
64 bytes from 192.168.1.3: icmp_seq=2 ttl=64 time=0.569 ms
64 bytes from 192.168.1.3: icmp_seq=3 ttl=64 time=0.498 ms
^C
--- 192.168.1.3 ping statistics ---
3 packets transmitted, 3 received, 0% packet loss, time 5ms
rtt min/avg/max/mdev = 0.498/0.668/0.938/0.194 ms
root@virbian:/home/user#
```

```
Virbian3 [Running] - Oracle VM VirtualBox
File Machine View Input Devices Help

root@virbian: /home/user

root@virbian:/home/user# ping 192.168.1.1
PING 192.168.1.1 (192.168.1.1) 56(84) bytes of data.
64 bytes from 192.168.1.1: icmp_seq=1 ttl=64 time=0.311 ms
64 bytes from 192.168.1.1: icmp_seq=2 ttl=64 time=0.920 ms
64 bytes from 192.168.1.1: icmp_seq=3 ttl=64 time=0.829 ms
^C
--- 192.168.1.1 ping statistics ---
3 packets transmitted, 3 received, 0% packet loss, time 23ms
rtt min/avg/max/mdev = 0.311/0.686/0.920/0.269 ms
root@virbian:/home/user# ping 192.168.1.2
PING 192.168.1.2 (192.168.1.2) 56(84) bytes of data.
64 bytes from 192.168.1.2: icmp_seq=1 ttl=64 time=0.495 ms
64 bytes from 192.168.1.2: icmp_seq=2 ttl=64 time=0.564 ms
64 bytes from 192.168.1.2: icmp_seq=3 ttl=64 time=0.786 ms
^C
--- 192.168.1.2 ping statistics ---
3 packets transmitted, 3 received, 0% packet loss, time 36ms
rtt min/avg/max/mdev = 0.495/0.615/0.786/0.124 ms
root@virbian:/home/user#
```


To samo powtarzamy dla sieci **local1**

```
Virbian3 [Running] - Oracle VM VirtualBox
File Machine View Input Devices Help

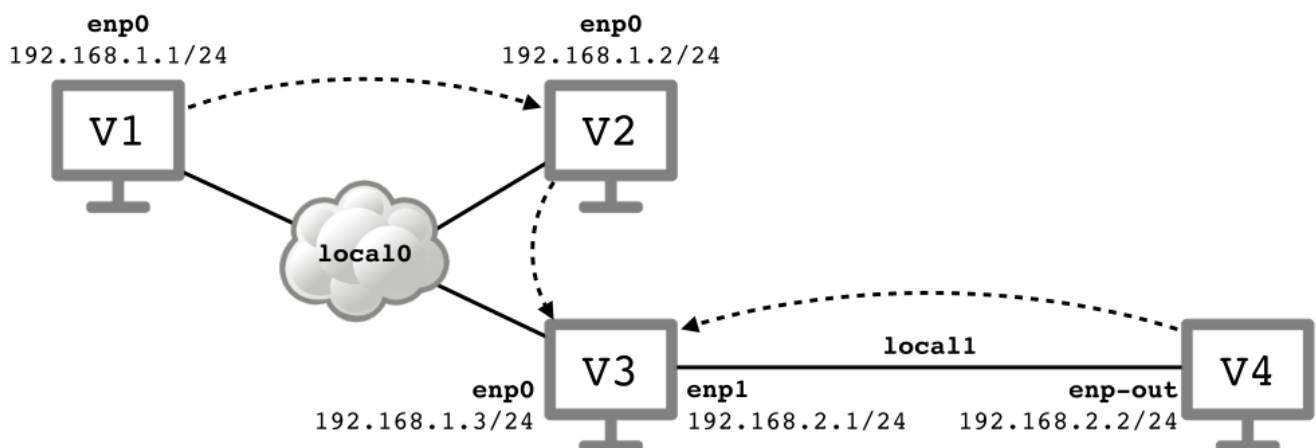
root@virbian: /home/user
root@virbian:/home/user# ping 192.168.2.2
PING 192.168.2.2 (192.168.2.2) 56(84) bytes of data.
64 bytes from 192.168.2.2: icmp_seq=1 ttl=64 time=1.25 ms
64 bytes from 192.168.2.2: icmp_seq=2 ttl=64 time=0.358 ms
64 bytes from 192.168.2.2: icmp_seq=3 ttl=64 time=0.704 ms
^C
--- 192.168.2.2 ping statistics ---
3 packets transmitted, 3 received, 0% packet loss, time 11ms
rtt min/avg/max/mdev = 0.358/0.769/1.247/0.367 ms
root@virbian:/home/user#

Virbian4 [Running] - Oracle VM VirtualBox
File Machine View Input Devices Help

root@virbian: /home/user
root@virbian:/home/user# ping 192.168.2.1
PING 192.168.2.1 (192.168.2.1) 56(84) bytes of data.
64 bytes from 192.168.2.1: icmp_seq=1 ttl=64 time=0.251 ms
64 bytes from 192.168.2.1: icmp_seq=2 ttl=64 time=0.851 ms
64 bytes from 192.168.2.1: icmp_seq=3 ttl=64 time=0.881 ms
^C
--- 192.168.2.1 ping statistics ---
3 packets transmitted, 3 received, 0% packet loss, time 8ms
rtt min/avg/max/mdev = 0.251/0.661/0.881/0.290 ms
root@virbian:/home/user#
```

Jak widać wszystkie połączenia zostały utworzone poprawnie.

Dodajemy teraz trasy domyślne z rysunku poniżej:



```
V1#> ip route add default via 192.168.1.2
V2#> ip route add default via 192.168.1.3
V4#> ip route add default via 192.168.2.1
```

Po otwarciu Wiresharka pingujemy z *Virbiana1* *Virbiana4*:

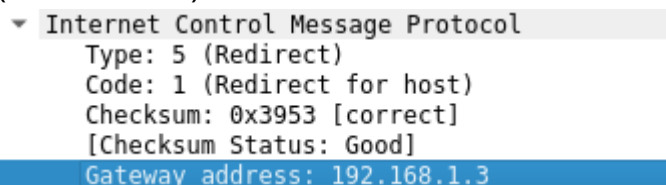
```
V1$> ping 192.168.2.2
```

The image shows a Wireshark packet capture window titled "Capturing from enp0". The interface includes a menu bar (File, Edit, View, Go, Capture, Analyze, Statistics, Telephony, Wireless, Tools, Help), a toolbar with various icons, and a display filter bar showing "Apply a display filter ... <Ctrl-/>". The main packet list table contains 28 entries. The first 14 packets are ICMP Redirects from 192.168.1.2 to 192.168.1.1. The next 14 packets are ICMP Echo (ping) requests and replies between 192.168.1.1 and 192.168.2.2. Below the packet list, the packet details pane shows the selected packet (No. 31) as an ICMP Echo (ping) request. The packet bytes pane shows the raw data in hexadecimal and ASCII. The status bar at the bottom indicates "enp0: <live capture in progress>" and "Packets: 28 · Displayed: 28 (100.0%) Profile: Default".

No.	Time	Source	Destination	Protocol	Length	Info
3	25.644618165	192.168.1.2	192.168.1.1	ICMP	126	Redirect (Redirect for host)
4	25.645258797	192.168.2.2	192.168.1.1	ICMP	98	Echo (ping) reply id=0x021a, seq=1/256
5	26.645777137	192.168.1.1	192.168.2.2	ICMP	98	Echo (ping) request id=0x021a, seq=2/512
6	26.646435787	192.168.1.2	192.168.1.1	ICMP	126	Redirect (Redirect for host)
7	26.647498133	192.168.2.2	192.168.1.1	ICMP	98	Echo (ping) reply id=0x021a, seq=2/512
8	27.647816757	192.168.1.1	192.168.2.2	ICMP	98	Echo (ping) request id=0x021a, seq=3/768
9	27.648555725	192.168.1.2	192.168.1.1	ICMP	126	Redirect (Redirect for host)
...	27.649800443	192.168.2.2	192.168.1.1	ICMP	98	Echo (ping) reply id=0x021a, seq=3/768
...	28.649109504	192.168.1.1	192.168.2.2	ICMP	98	Echo (ping) request id=0x021a, seq=4/102
...	28.649765119	192.168.1.2	192.168.1.1	ICMP	126	Redirect (Redirect for host)
...	28.650816230	192.168.2.2	192.168.1.1	ICMP	98	Echo (ping) reply id=0x021a, seq=4/102
...	29.650494771	192.168.1.1	192.168.2.2	ICMP	98	Echo (ping) request id=0x021a, seq=5/128
...	29.651111230	192.168.1.2	192.168.1.1	ICMP	126	Redirect (Redirect for host)
...	29.652126334	192.168.2.2	192.168.1.1	ICMP	98	Echo (ping) reply id=0x021a, seq=5/128
...	30.656503188	192.168.1.1	192.168.2.2	ICMP	98	Echo (ping) request id=0x021a, seq=6/153
...	30.657069109	192.168.1.2	192.168.1.1	ICMP	126	Redirect (Redirect for host)
...	30.657506862	192.168.2.2	192.168.1.1	ICMP	98	Echo (ping) reply id=0x021a, seq=6/153
...	30.684012254	PcsCompu_85:3f:1c	PcsCompu_49:4f:43	ARP	60	Who has 192.168.1.1? Tell 192.168.1.3
...	30.684029391	PcsCompu_49:4f:43	PcsCompu_85:3f:1c	ARP	42	192.168.1.1 is at 08:00:27:49:4f:43
...	30.693652665	PcsCompu_49:4f:43	PcsCompu_b5:4d:d5	ARP	42	Who has 192.168.1.2? Tell 192.168.1.1
...	30.694148112	PcsCompu_b5:4d:d5	PcsCompu_49:4f:43	ARP	60	192.168.1.2 is at 08:00:27:b5:4d:d5
...	30.767723541	PcsCompu_b5:4d:d5	PcsCompu_49:4f:43	ARP	60	Who has 192.168.1.1? Tell 192.168.1.2
...	30.767744650	PcsCompu_49:4f:43	PcsCompu_b5:4d:d5	ARP	42	192.168.1.1 is at 08:00:27:49:4f:43
...	31.657405377	192.168.1.1	192.168.2.2	ICMP	98	Echo (ping) request id=0x021a, seq=7/179
...	31.658058818	192.168.1.2	192.168.1.1	ICMP	126	Redirect (Redirect for host)
...	31.658871316	192.168.2.2	192.168.1.1	ICMP	98	Echo (ping) reply id=0x021a, seq=7/179

Jak widać na powyższym zrzucie ekranu, otrzymujemy odpowiedzi od *Virbiana4* (192.168.2.2) ale w Wiresharku pojawiają się również pakiety *redirect* od *Virbiana2* (192.168.1.2).

- Jaka jest sugerowana przez maszynę *Virbian2* modyfikacja tablicy routingu na maszynie *Virbian1*?
 - *odpowiedź*: *Virbian2* sugeruje aby zmienić trasę na taką, która przechodzi przez *Virbiana3* (192.168.1.3).



- Dlaczego taka zmiana ma sens?
 - *odpowiedź*: taka zmiana skróci trasę z *Virbiana1* do *Virbiana4*. Aktualnie pakiety muszą przechodzić przez *Virbiana2* do *Virbiana3* mimo, że *Virbian1* i *Virbian3* są bezpośrednio połączone przez sieć *local0*.
- W jaki sposób maszyna *Virbian2* mogła wykręcić powyższy problem?
 - *odpowiedź*: maszyna *Virbian2* mogła wykręcić powyższy problem przez to, że gdy przekazywała dalej pakiet, to musiała wysłać go przez ten sam interfejs, którym ten pakiet przyszedł, czyli

przez sieć, do której *Virbian1* również jest podłączony.