

**1. Skonfiguruj 5 maszyn wirtualnych Virbian1 –Virbian5, tak aby korzystały z sieci local0 – local4, tak jak zaznaczono na rysunku powyżej. Interfejsy maszyn podłączonych do sieci locali nazwij enp-loci .**

W zakładce sieci wybieramy następujące opcje dla poszczególnych maszyn:

- *Virbian1:*
  - *Adapter 1: Attached to: Internal Network      Name: local0*
- *Virbian2:*
  - *Adapter 1: Attached to: Internal Network      Name: local0*
  - *Adapter 2: Attached to: Internal Network      Name: local1*
  - *Adapter 3: Attached to: Internal Network      Name: local2*
- *Virbian3:*
  - *Adapter 2: Attached to: Internal Network      Name: local1*
  - *Adapter 4: Attached to: Internal Network      Name: local3*
- *Virbian4:*
  - *Adapter 1: Attached to: Internal Network      Name: local4*
  - *Adapter 3: Attached to: Internal Network      Name: local2*
  - *Adapter 4: Attached to: Internal Network      Name: local3*
- *Virbian5:*
  - *Adapter 1: Attached to: Internal Network      Name: local4*

Nazywamy interfejsy poszczególnych maszyn (informację o tym, jaki interfejs na danej maszynie odpowiada jakiej sieci możemy uzyskać porównując adresy MAC z interfejsu i z sekcji ustawień sieci maszyny):

- *Virbian1:*
  - *sudo ip link set enp0s3 name enp-loc0*
- *Virbian2:*
  - *sudo ip link set enp0s3 name enp-loc0*
  - *sudo ip link set enp0s8 name enp-loc1*
  - *sudo ip link set enp0s9 name enp-loc2*
- *Virbian3:*
  - *sudo ip link set enp0s8 name enp-loc1*
  - *sudo ip link set enp0s10 name enp-loc3*
- *Virbian4:*
  - *sudo ip link set enp0s3 name enp-loc4*
  - *sudo ip link set enp0s9 name enp-loc2*
  - *sudo ip link set enp0s10 name enp-loc3*
- *Virbian5:*
  - *sudo ip link set enp0s3 name enp-loc4*

**2. Niech sieci locali odpowiada zakres adresów 192.168.i.0/24. Przypisz dwóm interfejsom podłączonym do sieci locali wybrane adresy IP z sieci 192.168.i.0/24.**

Na każdej maszynie dany interfejs najpierw aktywujemy, a następnie przypisujemy adres wybrany zgodnie z poleceniem:

- Virbian1:
  - `sudo ip link set up dev enp-loc0`
  - `sudo ip addr add 192.168.0.1/24 dev enp-loc0`
- Virbian2:
  - `sudo ip link set up dev enp-loc0`
  - `sudo ip addr add 192.168.0.2/24 dev enp-loc0`
  - `sudo ip link set up dev enp-loc1`
  - `sudo ip addr add 192.168.1.1/24 dev enp-loc1`
  - `sudo ip link set up dev enp-loc2`
  - `sudo ip addr add 192.168.2.1/24 dev enp-loc2`
- Virbian3:
  - `sudo ip link set up dev enp-loc1`
  - `sudo ip addr add 192.168.1.2/24 dev enp-loc1`
  - `sudo ip link set up dev enp-loc3`
  - `sudo ip addr add 192.168.3.1/24 dev enp-loc3`
- Virbian4:
  - `sudo ip link set up dev enp-loc2`
  - `sudo ip addr add 192.168.2.2/24 dev enp-loc2`
  - `sudo ip link set up dev enp-loc3`
  - `sudo ip addr add 192.168.3.2/24 dev enp-loc3`
  - `sudo ip link set up dev enp-loc4`
  - `sudo ip addr add 192.168.4.1/24 dev enp-loc4`
- Virbian5:
  - `sudo ip link set up dev enp-loc4`
  - `sudo ip addr add 192.168.4.2/24 dev enp-loc4`

**3. Dla maszyny Virbian1 ustaw trasę domyślną przechodzącą przez maszynę Virbian2, zaś dla maszyny Virbian5 trasę domyślną przechodzącą przez maszynę Virbian4.**

Dla podanych maszyn dodajemy wpisy w tablicy routingu określające trasę domyślną za pomocą komend:

- Virbian1:
  - `sudo ip route add default via 192.168.0.2`
- Virbian5:
  - `sudo ip route add default via 192.168.4.1`

**4. Na maszynach Virbian2, Virbian3 i Virbian4 włącz protokół RIP (w wersji 2) dla wszystkich sieci podłączonych bezpośrednio do tych maszyn. Wyświetl zbudowane w ten sposób tablice routingu.**

Na każdej z podanych maszyn wykonujemy następujące operacje:

- tworzymy puste pliki konfiguracyjne:
  - `sudo touch /etc/quagga/ripd.conf`
  - `sudo touch /etc/quagga/zebra.conf`

- `sudo touch /etc/quagga/vtysh.conf`
- uruchamiamy usługę `ripd` i sprawdzamy, czy jest aktywna:
  - `sudo systemctl start ripd`
  - `sudo systemctl status ripd`

Dostajemy informację zwrotną z potwierdzeniem, że usługa jest aktywna:

```

File Machine View Input Devices Help
Virbian2 [Running] - Oracle VM VirtualBox
user@virbian:~$ sudo touch /etc/quagga/ripd.conf
user@virbian:~$ sudo touch /etc/quagga/zebra.conf
user@virbian:~$ sudo touch /etc/quagga/vtysh.conf
user@virbian:~$ sudo systemctl start ripd
user@virbian:~$ sudo systemctl status ripd
* ripd.service - RIP routing daemon
   Loaded: loaded (/lib/systemd/system/ripd.service; enabled; vendor preset: enabled)
   Active: active (running) since Sat 2020-04-04 22:49:15 CEST; 4s ago
     Docs: man:ripd
   Process: 502 ExecStartPre=/bin/chmod -f 640 /etc/quagga/ripd.conf (code=exited, status=0/SUCCESS)
   Process: 503 ExecStartPre=/bin/chown -f quagga:quagga /etc/quagga/ripd.conf (code=exited, status=0)
   Process: 504 ExecStart=/usr/sbin/ripd -d -A 127.0.0.1 -f /etc/quagga/ripd.conf (code=exited, status=0)
  Main PID: 505 (ripd)
    Tasks: 1 (limit: 1171)
   Memory: 1.0M
   CGroup: /system.slice/ripd.service
           └─505 /usr/sbin/ripd -d -A 127.0.0.1 -f /etc/quagga/ripd.conf

Apr 04 22:49:15 virbian systemd[1]: Starting RIP routing daemon...
Apr 04 22:49:15 virbian systemd[1]: Started RIP routing daemon.
lines 1-15/15 (END)

```

- wchodzimy w tryb konfiguracji routingu dynamicznego:
  - `sudo vtysh`
- następnie przechodzimy w tryb konfiguracji wewnątrz konfiguracji routingu dynamicznego:
  - `configure terminal`
- włączamy protokół RIP dla bezpośrednio podłączonych interfejsów sieci danej maszyny:
  - `Virbian2:`
    - `router rip`
    - `version 2`
    - `network 192.168.0.0/24`
    - `network 192.168.1.0/24`
    - `network 192.168.2.0/24`
  - `Virbian3:`
    - `router rip`
    - `version 2`
    - `network 192.168.1.0/24`
    - `network 192.168.3.0/24`
  - `Virbian4:`
    - `router rip`
    - `version 2`
    - `network 192.168.2.0/24`
    - `network 192.168.3.0/24`
    - `network 192.168.4.0/24`
- wychodzimy z trybu konfiguracyjnego Quagga poleceniem (tym samym wracamy do trybu wydawania poleceń Quagga):
  - `end`

- sprawdzamy czy prawidłowo skonfigurowaliśmy protokół RIP poleceniem:
  - *show running-config*
- wyświetlamy świeżo zbudowane tablice routingu poleceniem:
  - *show ip route*

Virbian2:

```
!
end
virbian# show ip route
Codes: K - kernel route, C - connected, S - static, R - RIP,
       O - OSPF, I - IS-IS, B - BGP, P - PIM, A - Babel, N - NHRP,
       > - selected route, * - FIB route

C>* 127.0.0.0/8 is directly connected, lo
C>* 192.168.0.0/24 is directly connected, enp-loc0
C>* 192.168.1.0/24 is directly connected, enp-loc1
C>* 192.168.2.0/24 is directly connected, enp-loc2
R>* 192.168.3.0/24 [120/2] via 192.168.1.2, enp-loc1, 00:02:41
R>* 192.168.4.0/24 [120/2] via 192.168.2.2, enp-loc2, 00:00:56
virbian#
```

Virbian3:

```
end
virbian# show ip route
Codes: K - kernel route, C - connected, S - static, R - RIP,
       O - OSPF, I - IS-IS, B - BGP, P - PIM, A - Babel, N - NHRP,
       > - selected route, * - FIB route

C>* 127.0.0.0/8 is directly connected, lo
R>* 192.168.0.0/24 [120/2] via 192.168.1.1, enp-loc1, 00:06:28
C>* 192.168.1.0/24 is directly connected, enp-loc1
R>* 192.168.2.0/24 [120/2] via 192.168.1.1, enp-loc1, 00:06:28
C>* 192.168.3.0/24 is directly connected, enp-loc3
R>* 192.168.4.0/24 [120/2] via 192.168.3.2, enp-loc3, 00:04:39
virbian#
```

Virbian4:

```
end
virbian# show ip route
Codes: K - kernel route, C - connected, S - static, R - RIP,
       O - OSPF, I - IS-IS, B - BGP, P - PIM, A - Babel, N - NHRP,
       > - selected route, * - FIB route

C>* 127.0.0.0/8 is directly connected, lo
R>* 192.168.0.0/24 [120/2] via 192.168.2.1, enp-loc2, 00:06:49
R>* 192.168.1.0/24 [120/2] via 192.168.2.1, enp-loc2, 00:06:49
C>* 192.168.2.0/24 is directly connected, enp-loc2
C>* 192.168.3.0/24 is directly connected, enp-loc3
C>* 192.168.4.0/24 is directly connected, enp-loc4
virbian#
```

Na koniec, jeśli chcemy wyjść z *Quagga*, wpisujemy komendę *exit*

**5. Sprawdź wzajemną osiągalność maszyn Virbian1, Virbian3 i Virbian5 poleceniem ping. Wyświetl trasy między tymi maszynami poleceniem traceroute. W razie potrzeby zidentyfikuj problem za pomocą Wiresharka.**

Z każdej podanej maszyny sprawdzamy osiągalność interfejsów pozostałych maszyn:

Virbian1:

```
Virbian1 [Running] - Oracle VM VirtualBox
File Machine View Input Devices Help
user@virbian:~$ ping 192.168.4.2
PING 192.168.4.2 (192.168.4.2) 56(84) bytes of data.
64 bytes from 192.168.4.2: icmp_seq=1 ttl=62 time=4.06 ms
64 bytes from 192.168.4.2: icmp_seq=2 ttl=62 time=1.97 ms
64 bytes from 192.168.4.2: icmp_seq=3 ttl=62 time=2.55 ms
^C
--- 192.168.4.2 ping statistics ---
3 packets transmitted, 3 received, 0% packet loss, time 5ms
rtt min/avg/max/mdev = 1.968/2.858/4.061/0.883 ms
user@virbian:~$ 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=63 time=1.80 ms
64 bytes from 192.168.1.2: icmp_seq=2 ttl=63 time=1.38 ms
64 bytes from 192.168.1.2: icmp_seq=3 ttl=63 time=1.93 ms
^C
--- 192.168.1.2 ping statistics ---
3 packets transmitted, 3 received, 0% packet loss, time 5ms
rtt min/avg/max/mdev = 1.382/1.706/1.934/0.240 ms
user@virbian:~$ ping 192.168.3.1
PING 192.168.3.1 (192.168.3.1) 56(84) bytes of data.
64 bytes from 192.168.3.1: icmp_seq=1 ttl=63 time=1.49 ms
64 bytes from 192.168.3.1: icmp_seq=2 ttl=63 time=1.97 ms
64 bytes from 192.168.3.1: icmp_seq=3 ttl=63 time=1.93 ms
^C
--- 192.168.3.1 ping statistics ---
3 packets transmitted, 3 received, 0% packet loss, time 5ms
rtt min/avg/max/mdev = 1.488/1.797/1.973/0.222 ms
user@virbian:~$ _
```

Virbian3:

```
Virbian3 [Running] - Oracle VM VirtualBox
File Machine View Input Devices Help
user@virbian:~$ ping 192.168.0.1
PING 192.168.0.1 (192.168.0.1) 56(84) bytes of data.
64 bytes from 192.168.0.1: icmp_seq=1 ttl=63 time=1.46 ms
64 bytes from 192.168.0.1: icmp_seq=2 ttl=63 time=1.85 ms
64 bytes from 192.168.0.1: icmp_seq=3 ttl=63 time=1.76 ms
^C
--- 192.168.0.1 ping statistics ---
3 packets transmitted, 3 received, 0% packet loss, time 5ms
rtt min/avg/max/mdev = 1.463/1.692/1.854/0.173 ms
user@virbian:~$ ping 192.168.4.2
PING 192.168.4.2 (192.168.4.2) 56(84) bytes of data.
64 bytes from 192.168.4.2: icmp_seq=1 ttl=63 time=1.33 ms
64 bytes from 192.168.4.2: icmp_seq=2 ttl=63 time=1.55 ms
64 bytes from 192.168.4.2: icmp_seq=3 ttl=63 time=1.59 ms
^C
--- 192.168.4.2 ping statistics ---
3 packets transmitted, 3 received, 0% packet loss, time 6ms
rtt min/avg/max/mdev = 1.330/1.488/1.589/0.121 ms
user@virbian:~$
```

Virbian5:

```
Virbian5 [Running] - Oracle VM VirtualBox
File Machine View Input Devices Help
user@virbian:~$ ping 192.168.0.1
PING 192.168.0.1 (192.168.0.1) 56(84) bytes of data.
64 bytes from 192.168.0.1: icmp_seq=1 ttl=62 time=2.41 ms
64 bytes from 192.168.0.1: icmp_seq=2 ttl=62 time=2.92 ms
64 bytes from 192.168.0.1: icmp_seq=3 ttl=62 time=2.76 ms
^C
--- 192.168.0.1 ping statistics ---
3 packets transmitted, 3 received, 0% packet loss, time 5ms
rtt min/avg/max/mdev = 2.412/2.696/2.920/0.211 ms
user@virbian:~$ 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=63 time=2.68 ms
64 bytes from 192.168.1.2: icmp_seq=2 ttl=63 time=1.98 ms
64 bytes from 192.168.1.2: icmp_seq=3 ttl=63 time=1.98 ms
^C
--- 192.168.1.2 ping statistics ---
3 packets transmitted, 3 received, 0% packet loss, time 5ms
rtt min/avg/max/mdev = 1.981/2.215/2.680/0.328 ms
user@virbian:~$ ping 192.168.3.1
PING 192.168.3.1 (192.168.3.1) 56(84) bytes of data.
64 bytes from 192.168.3.1: icmp_seq=1 ttl=63 time=1.62 ms
64 bytes from 192.168.3.1: icmp_seq=2 ttl=63 time=1.49 ms
64 bytes from 192.168.3.1: icmp_seq=3 ttl=63 time=1.68 ms
^C
--- 192.168.3.1 ping statistics ---
3 packets transmitted, 3 received, 0% packet loss, time 5ms
rtt min/avg/max/mdev = 1.492/1.595/1.675/0.089 ms
user@virbian:~$ _
```

Następnie wyświetlamy trasy:

Virbian1:

```
Virbian1 [Running] - Oracle VM VirtualBox
File Machine View Input Devices Help
user@virbian:~$ sudo traceroute -I 192.168.4.2
traceroute to 192.168.4.2 (192.168.4.2), 30 hops max, 60 byte packets
 1  192.168.0.2 (192.168.0.2)  0.662 ms  0.494 ms  0.362 ms
 2  192.168.2.2 (192.168.2.2)  1.362 ms  1.456 ms  3.443 ms
 3  192.168.4.2 (192.168.4.2)  3.309 ms  3.171 ms  3.028 ms
user@virbian:~$ sudo traceroute -I 192.168.1.2
traceroute to 192.168.1.2 (192.168.1.2), 30 hops max, 60 byte packets
 1  192.168.0.2 (192.168.0.2)  0.380 ms  0.450 ms  0.378 ms
 2  192.168.1.2 (192.168.1.2)  1.028 ms  1.118 ms  0.943 ms
user@virbian:~$ sudo traceroute -I 192.168.3.1
traceroute to 192.168.3.1 (192.168.3.1), 30 hops max, 60 byte packets
 1  192.168.0.2 (192.168.0.2)  0.767 ms  0.765 ms  0.605 ms
 2  192.168.3.1 (192.168.3.1)  1.326 ms  1.085 ms  1.028 ms
user@virbian:~$ _
```

Virbian3:

```
Virbian3 [Running] - Oracle VM VirtualBox
File Machine View Input Devices Help
user@virbian:~$ sudo traceroute -I 192.168.4.2
traceroute to 192.168.4.2 (192.168.4.2), 30 hops max, 60 byte packets
 1 192.168.3.2 (192.168.3.2) 0.707 ms 0.475 ms 0.325 ms
 2 192.168.4.2 (192.168.4.2) 3.867 ms 4.016 ms 3.823 ms
user@virbian:~$ sudo traceroute -I 192.168.0.1
traceroute to 192.168.0.1 (192.168.0.1), 30 hops max, 60 byte packets
 1 192.168.1.1 (192.168.1.1) 0.645 ms 0.404 ms 0.257 ms
 2 192.168.0.1 (192.168.0.1) 0.917 ms 0.760 ms 0.620 ms
user@virbian:~$ _
```

Virbian5:

```
Virbian5 [Running] - Oracle VM VirtualBox
File Machine View Input Devices Help
user@virbian:~$ sudo traceroute -I 192.168.0.1
traceroute to 192.168.0.1 (192.168.0.1), 30 hops max, 60 byte packets
 1 192.168.4.1 (192.168.4.1) 0.757 ms 0.556 ms 0.447 ms
 2 192.168.2.1 (192.168.2.1) 2.380 ms 2.596 ms 2.806 ms
 3 192.168.0.1 (192.168.0.1) 4.706 ms 4.895 ms 5.751 ms
user@virbian:~$ sudo traceroute -I 192.168.3.1
traceroute to 192.168.3.1 (192.168.3.1), 30 hops max, 60 byte packets
 1 192.168.4.1 (192.168.4.1) 0.425 ms 0.269 ms 0.179 ms
 2 192.168.3.1 (192.168.3.1) 1.063 ms 1.041 ms 1.042 ms
user@virbian:~$ sudo traceroute -I 192.168.1.2
traceroute to 192.168.1.2 (192.168.1.2), 30 hops max, 60 byte packets
 1 192.168.4.1 (192.168.4.1) 0.436 ms 0.364 ms 0.212 ms
 2 192.168.2.1 (192.168.2.1) 0.497 ms 0.554 ms 0.431 ms
 3 192.168.1.2 (192.168.1.2) 1.085 ms 1.160 ms 1.098 ms
user@virbian:~$
```