

## **CS3543 Lab Assignment for Jan 18th (Deadline: 23:59 on January 22rd (WED), 2019)**

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### **# General Information**

1. This assignment can be conducted and submitted by a per (up to 2) of students. The same mark will be offered to the pair of students regardless of individual contributions.
2. The assignment is customized for Ubuntu + KVM environment. It is highly recommended for non-Ubuntu users to enable dual boot on your laptop computer and install Ubuntu. If you would like to work on another operating system and virtualization platform, you need to interpret the Ubuntu/KVM terminology to another environment's terminology.
3. Each individual or pair can create a local copy of this question file, give the answer to the local copy, and submit in a form of PDF file.
4. Only one submission is good enough as far as the student name and ID are properly mentioned.
5. Do not send any private comment to separately mention the buddy.

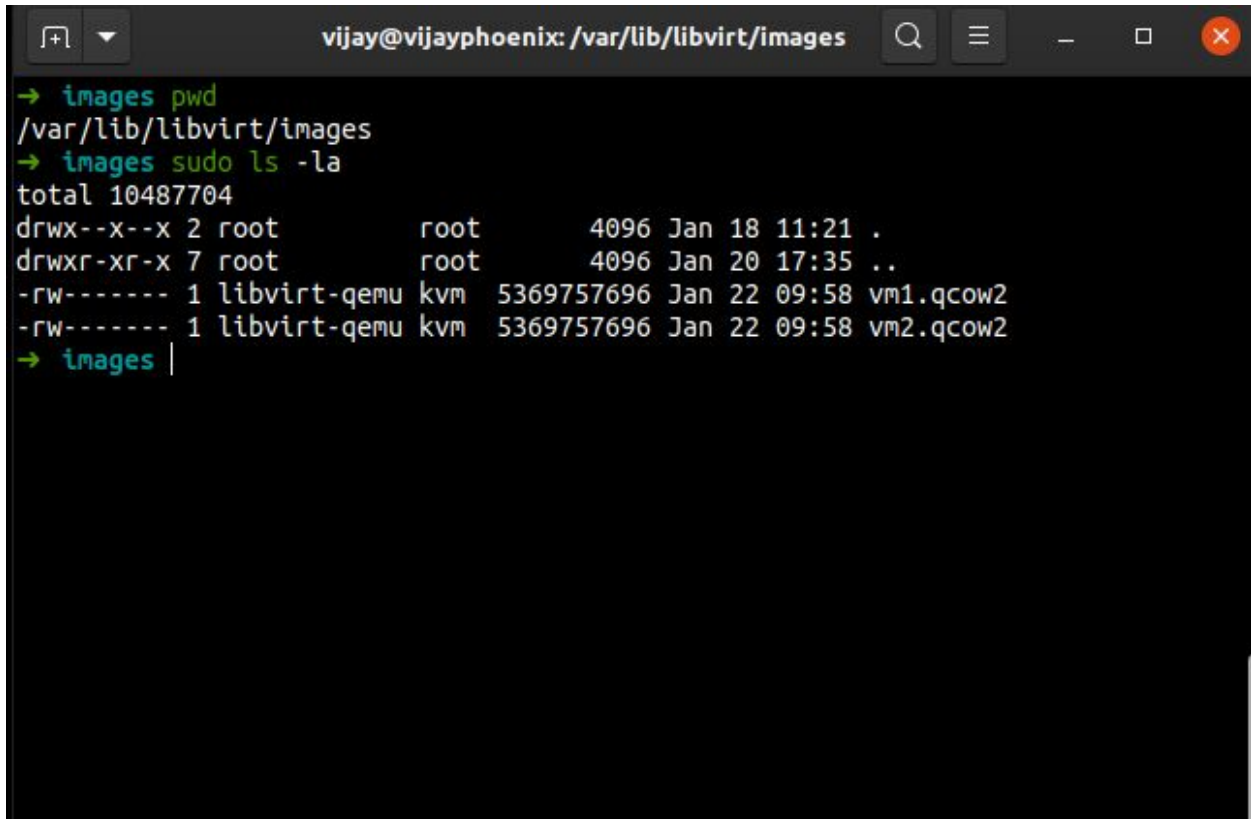
**Question 1.**

Fill the blanks in the following table in your VM environment. Be noted that yellow-marked blanks are to be filled as answer of Question 5.1.

	VyOS1	VyOS2	VyOS3
IPv4 Address and Subnet Mask given to eth0	192.168.101.12/24	192.168.101.10/24	192.168.102.13/24
IPv6 Address and Subnet Mask given to eth0	2013:abcd:101::12/64	2013:abcd:101::10/64	2013:abcd:102::13/64
MAC Address of eth0	52:54:00:37:0a:4e	52:54:00:f2:b4:5c	52:54:00:3c:77:ce
Bridge I/F selected for connecting eth0	bri0	bri0	bri1
IPv4 Address and Subnet Mask given to eth1	N/A	192.168.102.10/24	N/A
IPv6 Address and Subnet Mask given to eth1	N/A	2013:abcd:102::10/64	N/A
MAC Address of eth1	N/A	52:54:00:e8:d1:89	N/A
Bridge I/F selected for connecting eth1	N/A	bri1	N/A

**Question 2.**

Show the file name and the full path to the disk image file (not ISO image) of VyOS1 in Host Ubuntu's file system. You may answer by pasting the screen capture of the result of "ls -al" command in the directly where the said image file is stored.



```
vijay@vijayphoenix: /var/lib/libvirt/images
→ images pwd
/var/lib/libvirt/images
→ images sudo ls -la
total 10487704
drwx--x--x 2 root      root      4096 Jan 18 11:21 .
drwxr-xr-x 7 root      root      4096 Jan 20 17:35 ..
-rw----- 1 libvirt-qemu kvm    5369757696 Jan 22 09:58 vm1.qcow2
-rw----- 1 libvirt-qemu kvm    5369757696 Jan 22 09:58 vm2.qcow2
→ images |
```

### Question 3.

Show that both ping and ping6 are successful between VyOS1 and VyOS2. You may answer by pasting the screen capture of the result of both commands.

Ping :

VyOS1:

```
vm1 on QEMU/KVM
File Virtual Machine View Send Key
[Icons]
vyos@vyos:~$ show interfaces
Codes: S - State, L - Link, u - Up, D - Down, A - Admin Down
Interface      IP Address      S/L  Description
-----
eth0           192.168.101.12/24  u/u
lo             127.0.0.1/8      u/u
::1/128
vyos@vyos:~$ ping 192.168.101.10
PING 192.168.101.10 (192.168.101.10) 56(84) bytes of data.
64 bytes from 192.168.101.10: icmp_req=1 ttl=64 time=0.356 ms
64 bytes from 192.168.101.10: icmp_req=2 ttl=64 time=0.613 ms
64 bytes from 192.168.101.10: icmp_req=3 ttl=64 time=0.637 ms
64 bytes from 192.168.101.10: icmp_req=4 ttl=64 time=0.404 ms
64 bytes from 192.168.101.10: icmp_req=5 ttl=64 time=0.608 ms
64 bytes from 192.168.101.10: icmp_req=6 ttl=64 time=0.532 ms
[ ]
```

VyOS2:

```
vm2 on QEMU/KVM
File Virtual Machine View Send Key
[Icons]
vyos@vyos:~$ show interfaces
Codes: S - State, L - Link, u - Up, D - Down, A - Admin Down
Interface      IP Address      S/L  Description
-----
eth0           192.168.101.10/24  u/u
lo             127.0.0.1/8      u/u
::1/128
vyos@vyos:~$ ping 192.168.101.12
PING 192.168.101.12 (192.168.101.12) 56(84) bytes of data.
64 bytes from 192.168.101.12: icmp_req=1 ttl=64 time=0.243 ms
64 bytes from 192.168.101.12: icmp_req=2 ttl=64 time=0.411 ms
64 bytes from 192.168.101.12: icmp_req=3 ttl=64 time=0.596 ms
64 bytes from 192.168.101.12: icmp_req=4 ttl=64 time=0.578 ms
64 bytes from 192.168.101.12: icmp_req=5 ttl=64 time=0.553 ms
[ ]
```

Ping6:

VyOS1:

```
vm1 on QEMU/KVM
File Virtual Machine View Send Key
[Icons: Monitor, Info, Play, Pause, Power, Dropdown, Copy]

vyos@vyos:~$ show interfaces
Codes: S - State, L - Link, u - Up, D - Down, A - Admin Down
Interface      IP Address      S/L  Description
-----
eth0            192.168.101.12/24  u/u
                2013:abcd:101::12/64
lo              127.0.0.1/8      u/u
                ::1/128
vyos@vyos:~$ ping6 2013:abcd:101::10
PING 2013:abcd:101::10(2013:abcd:101::10) 56 data bytes
64 bytes from 2013:abcd:101::10: icmp_seq=1 ttl=64 time=0.680 ms
64 bytes from 2013:abcd:101::10: icmp_seq=2 ttl=64 time=0.487 ms
64 bytes from 2013:abcd:101::10: icmp_seq=3 ttl=64 time=0.664 ms
64 bytes from 2013:abcd:101::10: icmp_seq=4 ttl=64 time=0.601 ms
64 bytes from 2013:abcd:101::10: icmp_seq=5 ttl=64 time=0.617 ms
64 bytes from 2013:abcd:101::10: icmp_seq=6 ttl=64 time=0.574 ms
64 bytes from 2013:abcd:101::10: icmp_seq=7 ttl=64 time=0.530 ms
64 bytes from 2013:abcd:101::10: icmp_seq=8 ttl=64 time=0.659 ms
[Cursor]
```

VyOS2:

```
vm2 on QEMU/KVM
File Virtual Machine View Send Key
[Icons: Monitor, Info, Play, Pause, Power, Dropdown, Copy]

vyos@vyos:~$ show interfaces
Codes: S - State, L - Link, u - Up, D - Down, A - Admin Down
Interface      IP Address      S/L  Description
-----
eth0            192.168.101.10/24  u/u
                2013:abcd:101::10/64
lo              127.0.0.1/8      u/u
                ::1/128
vyos@vyos:~$ ping6 2013:abcd:101::12
PING 2013:abcd:101::12(2013:abcd:101::12) 56 data bytes
64 bytes from 2013:abcd:101::12: icmp_seq=1 ttl=64 time=0.632 ms
64 bytes from 2013:abcd:101::12: icmp_seq=2 ttl=64 time=0.628 ms
64 bytes from 2013:abcd:101::12: icmp_seq=3 ttl=64 time=0.567 ms
64 bytes from 2013:abcd:101::12: icmp_seq=4 ttl=64 time=0.562 ms
64 bytes from 2013:abcd:101::12: icmp_seq=5 ttl=64 time=0.670 ms
64 bytes from 2013:abcd:101::12: icmp_seq=6 ttl=64 time=0.554 ms
64 bytes from 2013:abcd:101::12: icmp_seq=7 ttl=64 time=0.656 ms
[Cursor]
```

#### Question 4.

Show the result of iperf and check the TCP throughput from VyOS1 (client) to VyOS2 (server) using IPv4 and IPv6 respectively. You may answer by pasting the screen capture of the result of both commands.

IPv4:

VyOS1:

```
vm1 on QEMU/KVM
File Virtual Machine View Send Key
[Icons: Monitor, Info, Play, Pause, Power, Dropdown, Copy]
vyos@vyos:~$ show interfaces
Codes: S - State, L - Link, u - Up, D - Down, A - Admin Down
Interface      IP Address      S/L  Description
-----
eth0           192.168.101.12/24  u/u
              2013:abcd:101::12/64
lo             127.0.0.1/8      u/u
              ::1/128
vyos@vyos:~$ iperf -c 192.168.101.10
-----
Client connecting to 192.168.101.10, TCP port 5001
TCP window size: 85.0 KByte (default)
-----
[ 3] local 192.168.101.12 port 38591 connected with 192.168.101.10 port 5001
[ ID] Interval      Transfer      Bandwidth
[ 3]  0.0-10.0 sec  22.0 GBytes  18.9 Gbits/sec
vyos@vyos:~$
```

VyOS2:

```
vm2 on QEMU/KVM
File Virtual Machine View Send Key
[Icons: Monitor, Info, Play, Pause, Power, Dropdown, Copy]
vyos@vyos:~$ show interfaces
Codes: S - State, L - Link, u - Up, D - Down, A - Admin Down
Interface      IP Address      S/L  Description
-----
eth0           192.168.101.10/24  u/u
              2013:abcd:101::10/64
lo             127.0.0.1/8      u/u
              ::1/128
vyos@vyos:~$ iperf -s
-----
Server listening on TCP port 5001
TCP window size: 85.3 KByte (default)
-----
[ 4] local 192.168.101.10 port 5001 connected with 192.168.101.12 port 38591
[ ID] Interval      Transfer      Bandwidth
[ 4]  0.0-10.0 sec  22.0 GBytes  18.8 Gbits/sec
[
```



IPv6:

VyOS1:

```
vm1 on QEMU/KVM
File Virtual Machine View Send Key
[Icons: Monitor, Info, Play, Pause, Power, Dropdown, Copy]

vyos@vyos:~$ show interfaces
Codes: S - State, L - Link, u - Up, D - Down, A - Admin Down
Interface      IP Address      S/L  Description
-----
eth0           192.168.101.12/24  u/u
              2013:abcd:101::12/64
lo             127.0.0.1/8      u/u
              ::1/128
vyos@vyos:~$ iperf -V -c 2013:abcd:101::10
-----
Client connecting to 2013:abcd:101::10, TCP port 5001
TCP window size: 45.0 KByte (default)
-----
[ 3] local 2013:abcd:101::12 port 45852 connected with 2013:abcd:101::10 port 5001
[ ID] Interval      Transfer      Bandwidth
[ 3]  0.0-10.0 sec  21.5 GBytes  18.5 Gbits/sec
vyos@vyos:~$
```

VyOS2:

```
vm2 on QEMU/KVM
File Virtual Machine View Send Key
[Icons: Monitor, Info, Play, Pause, Power, Dropdown, Copy]

vyos@vyos:~$ show interfaces
Codes: S - State, L - Link, u - Up, D - Down, A - Admin Down
Interface      IP Address      S/L  Description
-----
eth0           192.168.101.10/24  u/u
              2013:abcd:101::10/64
lo             127.0.0.1/8      u/u
              ::1/128
vyos@vyos:~$ iperf -V -s
-----
Server listening on TCP port 5001
TCP window size: 85.3 KByte (default)
-----
[ 4] local 2013:abcd:101::10 port 5001 connected with 2013:abcd:101::12 port 45852
[ ID] Interval      Transfer      Bandwidth
[ 4]  0.0-10.0 sec  21.5 GBytes  18.4 Gbits/sec
█
```

5. Install VyOS3 and connect to VyOS2 using a new bridge I/F referring the network diagram in the course material. The goal of this task is to allow VyOS1 and VyOS3 to successfully ping, ping6 and iperf (using both IPv4 and IPv6) with each other in the following network diagram.

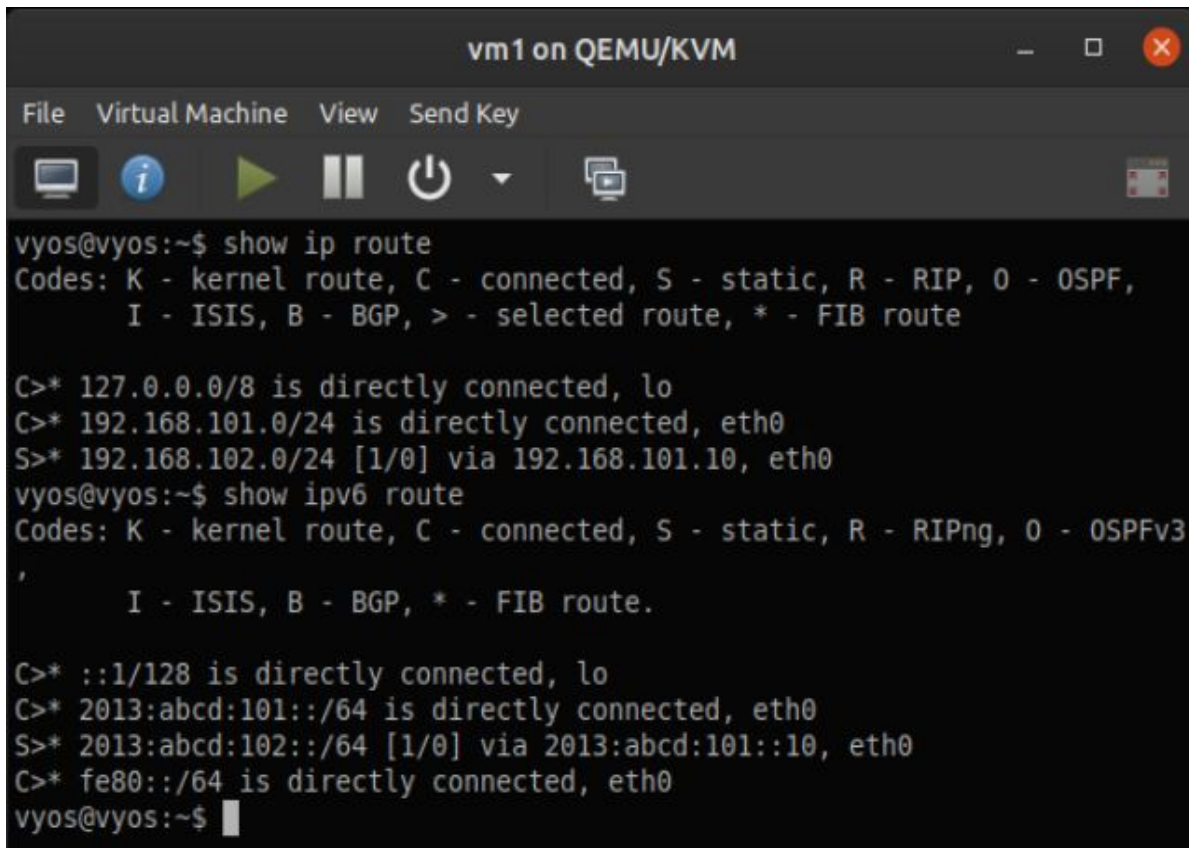
Question 5.1.

Configure the network interface “eth1” of VyOS2 and “eth0” of VyOS3 and fill the blank in the table given in Question 1.

Question 5.2.

Configure the routing tables on VyOS1, VyOS2 and VyOS3 respectively, and paste the screen captures of respective routing tables.

VyOS1:



```
vm1 on QEMU/KVM
File Virtual Machine View Send Key
[Icons: Monitor, Info, Play, Pause, Power, Dropdown, Copy]

vyos@vyos:~$ show ip route
Codes: K - kernel route, C - connected, S - static, R - RIP, O - OSPF,
      I - ISIS, B - BGP, > - selected route, * - FIB route

C>* 127.0.0.0/8 is directly connected, lo
C>* 192.168.101.0/24 is directly connected, eth0
S>* 192.168.102.0/24 [1/0] via 192.168.101.10, eth0
vyos@vyos:~$ show ipv6 route
Codes: K - kernel route, C - connected, S - static, R - RIPng, O - OSPFv3
      I - ISIS, B - BGP, * - FIB route.

C>* ::1/128 is directly connected, lo
C>* 2013:abcd:101::/64 is directly connected, eth0
S>* 2013:abcd:102::/64 [1/0] via 2013:abcd:101::10, eth0
C>* fe80::/64 is directly connected, eth0
vyos@vyos:~$
```



## VyOS2:

```
vm2 on QEMU/KVM
File Virtual Machine View Send Key
[Icons: Monitor, Info, Play, Pause, Power, Dropdown, Copy]

vyos@vyos:~$ show ip route
Codes: K - kernel route, C - connected, S - static, R - RIP, O - OSPF,
       I - ISIS, B - BGP, > - selected route, * - FIB route

C>* 127.0.0.0/8 is directly connected, lo
S   192.168.101.0/24 [1/0] via 192.168.101.0 inactive
C>* 192.168.101.0/24 is directly connected, eth0
S   192.168.102.0/24 [1/0] via 192.168.102.0 inactive
C>* 192.168.102.0/24 is directly connected, eth1
vyos@vyos:~$ show ipv6 route
Codes: K - kernel route, C - connected, S - static, R - RIPng, O - OSPFv3,
       I - ISIS, B - BGP, * - FIB route.

C>* ::1/128 is directly connected, lo
S   2013:abcd:101::/64 [1/0] via 2013:abcd:101:: inactive
C>* 2013:abcd:101::/64 is directly connected, eth0
S   2013:abcd:102::/64 [1/0] via 2013:abcd:102:: inactive
C>* 2013:abcd:102::/64 is directly connected, eth1
C * fe80::/64 is directly connected, eth1
C>* fe80::/64 is directly connected, eth0
vyos@vyos:~$
```

## VyOS3:

```
vm3 on QEMU/KVM
File Virtual Machine View Send Key
[Icons: Monitor, Info, Play, Pause, Power, Dropdown, Copy, Red X]

vyos@vyos:~$ show ip route
Codes: K - kernel route, C - connected, S - static, R - RIP, O - OSPF,
       I - ISIS, B - BGP, > - selected route, * - FIB route

C>* 127.0.0.0/8 is directly connected, lo
S>* 192.168.101.0/24 [1/0] via 192.168.102.10, eth0
C>* 192.168.102.0/24 is directly connected, eth0
vyos@vyos:~$ show ipv6 route
Codes: K - kernel route, C - connected, S - static, R - RIPng, O - OSPFv3,
       I - ISIS, B - BGP, * - FIB route.

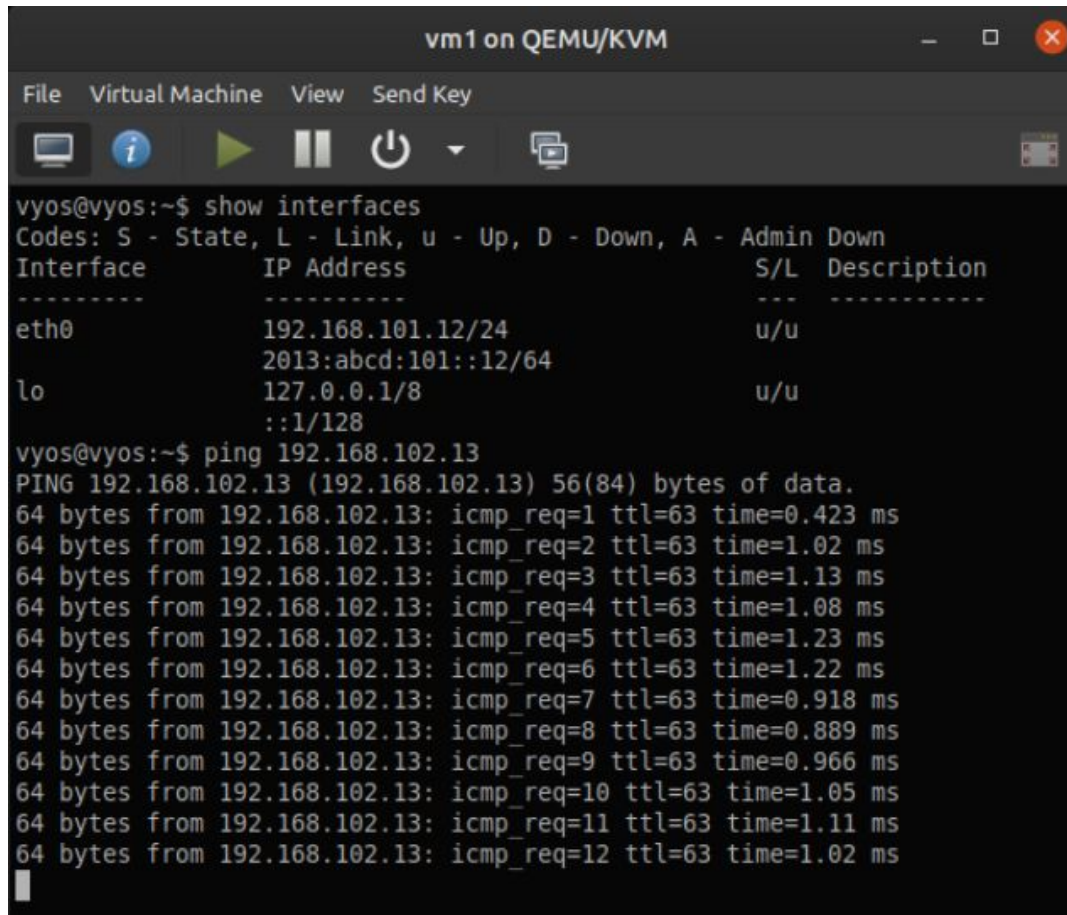
C>* ::1/128 is directly connected, lo
S>* 2013:abcd:101::/64 [1/0] via 2013:abcd:102::10, eth0
C>* 2013:abcd:102::/64 is directly connected, eth0
C>* fe80::/64 is directly connected, eth0
vyos@vyos:~$
```

### Question 5.3.

Show that both ping and ping6 are successful between VyOS1 and VyOS3. You may answer by pasting the screen capture of the result of both commands.

ping:

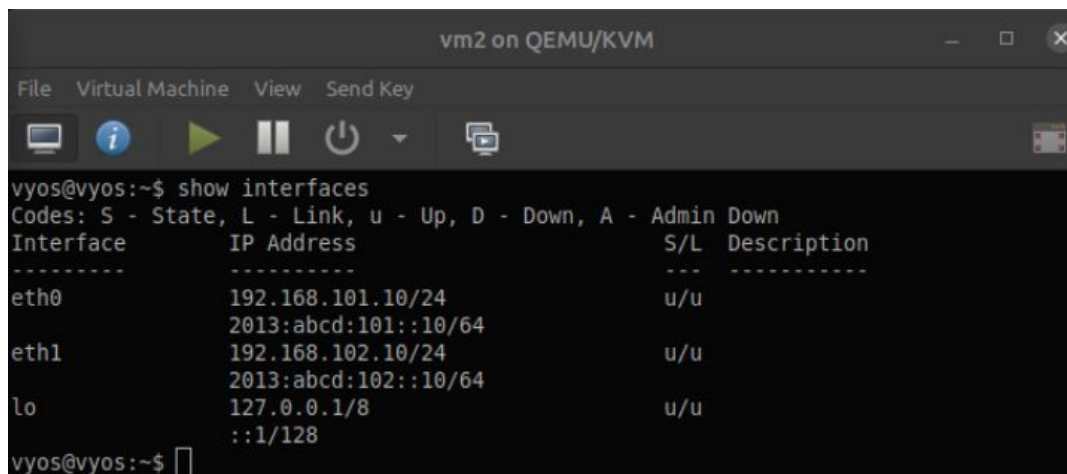
VyOS1:



```
vm1 on QEMU/KVM
File Virtual Machine View Send Key
[Icons: Monitor, Info, Play, Pause, Power, Dropdown, Copy]

vyos@vyos:~$ show interfaces
Codes: S - State, L - Link, u - Up, D - Down, A - Admin Down
Interface      IP Address      S/L  Description
-----
eth0            192.168.101.12/24  u/u
                2013:abcd:101::12/64
lo              127.0.0.1/8      u/u
                ::1/128
vyos@vyos:~$ ping 192.168.102.13
PING 192.168.102.13 (192.168.102.13) 56(84) bytes of data.
64 bytes from 192.168.102.13: icmp_req=1 ttl=63 time=0.423 ms
64 bytes from 192.168.102.13: icmp_req=2 ttl=63 time=1.02 ms
64 bytes from 192.168.102.13: icmp_req=3 ttl=63 time=1.13 ms
64 bytes from 192.168.102.13: icmp_req=4 ttl=63 time=1.08 ms
64 bytes from 192.168.102.13: icmp_req=5 ttl=63 time=1.23 ms
64 bytes from 192.168.102.13: icmp_req=6 ttl=63 time=1.22 ms
64 bytes from 192.168.102.13: icmp_req=7 ttl=63 time=0.918 ms
64 bytes from 192.168.102.13: icmp_req=8 ttl=63 time=0.889 ms
64 bytes from 192.168.102.13: icmp_req=9 ttl=63 time=0.966 ms
64 bytes from 192.168.102.13: icmp_req=10 ttl=63 time=1.05 ms
64 bytes from 192.168.102.13: icmp_req=11 ttl=63 time=1.11 ms
64 bytes from 192.168.102.13: icmp_req=12 ttl=63 time=1.02 ms
```

VyOS2:



```
vm2 on QEMU/KVM
File Virtual Machine View Send Key
[Icons: Monitor, Info, Play, Pause, Power, Dropdown, Copy]

vyos@vyos:~$ show interfaces
Codes: S - State, L - Link, u - Up, D - Down, A - Admin Down
Interface      IP Address      S/L  Description
-----
eth0            192.168.101.10/24  u/u
                2013:abcd:101::10/64
eth1            192.168.102.10/24  u/u
                2013:abcd:102::10/64
lo              127.0.0.1/8      u/u
                ::1/128
vyos@vyos:~$
```

### VyOS3:

```
vm3 on QEMU/KVM
File Virtual Machine View Send Key
[Icons: Monitor, Info, Play, Pause, Power, Dropdown, Copy]

vyos@vyos:~$ show interfaces
Codes: S - State, L - Link, u - Up, D - Down, A - Admin Down
Interface      IP Address      S/L  Description
-----
eth0            192.168.102.13/24  u/u
                2013:abcd:102::13/64
lo              127.0.0.1/8      u/u
                ::1/128

vyos@vyos:~$ ping 192.168.101.12
PING 192.168.101.12 (192.168.101.12) 56(84) bytes of data.
64 bytes from 192.168.101.12: icmp_req=1 ttl=63 time=0.369 ms
64 bytes from 192.168.101.12: icmp_req=2 ttl=63 time=0.438 ms
64 bytes from 192.168.101.12: icmp_req=3 ttl=63 time=0.888 ms
64 bytes from 192.168.101.12: icmp_req=4 ttl=63 time=0.806 ms
64 bytes from 192.168.101.12: icmp_req=5 ttl=63 time=1.05 ms
64 bytes from 192.168.101.12: icmp_req=6 ttl=63 time=1.08 ms
64 bytes from 192.168.101.12: icmp_req=7 ttl=63 time=1.04 ms
64 bytes from 192.168.101.12: icmp_req=8 ttl=63 time=0.973 ms
64 bytes from 192.168.101.12: icmp_req=9 ttl=63 time=1.01 ms
64 bytes from 192.168.101.12: icmp_req=10 ttl=63 time=1.07 ms
64 bytes from 192.168.101.12: icmp_req=11 ttl=63 time=1.23 ms
64 bytes from 192.168.101.12: icmp_req=12 ttl=63 time=1.04 ms
64 bytes from 192.168.101.12: icmp_req=13 ttl=63 time=1.15 ms
64 bytes from 192.168.101.12: icmp_req=14 ttl=63 time=0.949 ms
[ ]
```



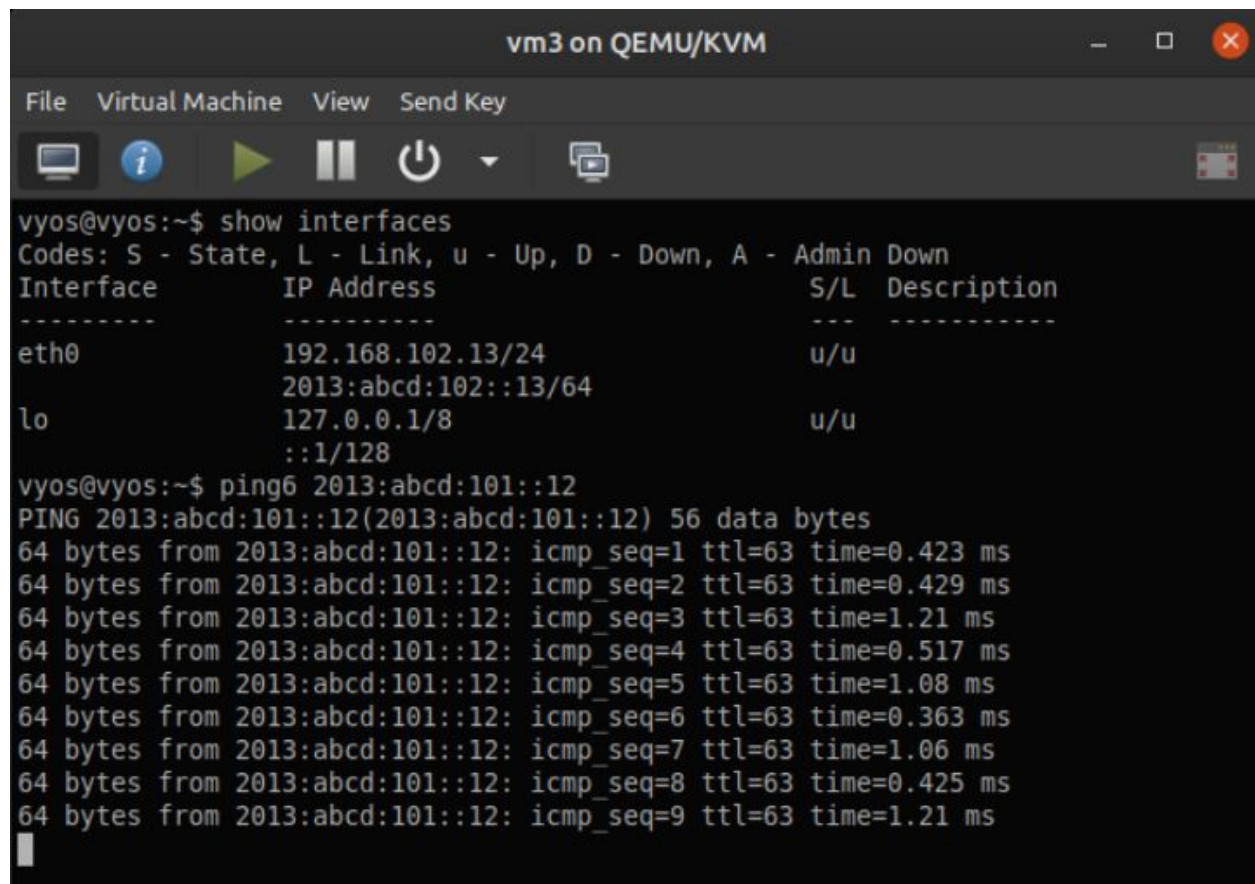
ping6:  
VyOS1:

```
vm1 on QEMU/KVM
File Virtual Machine View Send Key
[Icons: Monitor, Info, Play, Pause, Power, Dropdown, Copy]
vyos@vyos:~$ show interfaces
Codes: S - State, L - Link, u - Up, D - Down, A - Admin Down
Interface      IP Address      S/L  Description
-----
eth0           192.168.101.12/24  u/u
               2013:abcd:101::12/64
lo             127.0.0.1/8      u/u
               ::1/128
vyos@vyos:~$ ping6 2013:abcd:102::13
PING 2013:abcd:102::13(2013:abcd:102::13) 56 data bytes
64 bytes from 2013:abcd:102::13: icmp_seq=1 ttl=63 time=1.08 ms
64 bytes from 2013:abcd:102::13: icmp_seq=2 ttl=63 time=1.12 ms
64 bytes from 2013:abcd:102::13: icmp_seq=3 ttl=63 time=1.18 ms
64 bytes from 2013:abcd:102::13: icmp_seq=4 ttl=63 time=1.14 ms
64 bytes from 2013:abcd:102::13: icmp_seq=5 ttl=63 time=1.19 ms
64 bytes from 2013:abcd:102::13: icmp_seq=6 ttl=63 time=1.09 ms
64 bytes from 2013:abcd:102::13: icmp_seq=7 ttl=63 time=1.17 ms
64 bytes from 2013:abcd:102::13: icmp_seq=8 ttl=63 time=1.57 ms
64 bytes from 2013:abcd:102::13: icmp_seq=9 ttl=63 time=1.12 ms
64 bytes from 2013:abcd:102::13: icmp_seq=10 ttl=63 time=1.00 ms
[Cursor]
```

VyOS2:

```
vm2 on QEMU/KVM
File Virtual Machine View Send Key
[Icons: Monitor, Info, Play, Pause, Power, Dropdown, Copy]
vyos@vyos:~$ show interfaces
Codes: S - State, L - Link, u - Up, D - Down, A - Admin Down
Interface      IP Address      S/L  Description
-----
eth0           192.168.101.10/24  u/u
               2013:abcd:101::10/64
eth1           192.168.102.10/24  u/u
               2013:abcd:102::10/64
lo             127.0.0.1/8      u/u
               ::1/128
vyos@vyos:~$ [Cursor]
```

VyOS3:



```
vm3 on QEMU/KVM
File Virtual Machine View Send Key
[Icons: Monitor, Info, Play, Pause, Power, Dropdown, Copy, Close]

vyos@vyos:~$ show interfaces
Codes: S - State, L - Link, u - Up, D - Down, A - Admin Down
Interface      IP Address      S/L  Description
-----
eth0           192.168.102.13/24  u/u
               2013:abcd:102::13/64
lo             127.0.0.1/8      u/u
               ::1/128

vyos@vyos:~$ ping6 2013:abcd:101::12
PING 2013:abcd:101::12(2013:abcd:101::12) 56 data bytes
64 bytes from 2013:abcd:101::12: icmp_seq=1 ttl=63 time=0.423 ms
64 bytes from 2013:abcd:101::12: icmp_seq=2 ttl=63 time=0.429 ms
64 bytes from 2013:abcd:101::12: icmp_seq=3 ttl=63 time=1.21 ms
64 bytes from 2013:abcd:101::12: icmp_seq=4 ttl=63 time=0.517 ms
64 bytes from 2013:abcd:101::12: icmp_seq=5 ttl=63 time=1.08 ms
64 bytes from 2013:abcd:101::12: icmp_seq=6 ttl=63 time=0.363 ms
64 bytes from 2013:abcd:101::12: icmp_seq=7 ttl=63 time=1.06 ms
64 bytes from 2013:abcd:101::12: icmp_seq=8 ttl=63 time=0.425 ms
64 bytes from 2013:abcd:101::12: icmp_seq=9 ttl=63 time=1.21 ms
█
```



#### Question 5.4.

- a) Show the result of iperf and check the TCP throughput from VyOS1 (client) to VyOS3 (server) using IPv4 and IPv6 respectively. You may answer by pasting the screen capture of the result of both commands.

IPv4:

VyOS1:

```
vm1 on QEMU/KVM
File Virtual Machine View Send Key
[Icons: Monitor, Info, Play, Pause, Power, Dropdown, Share]

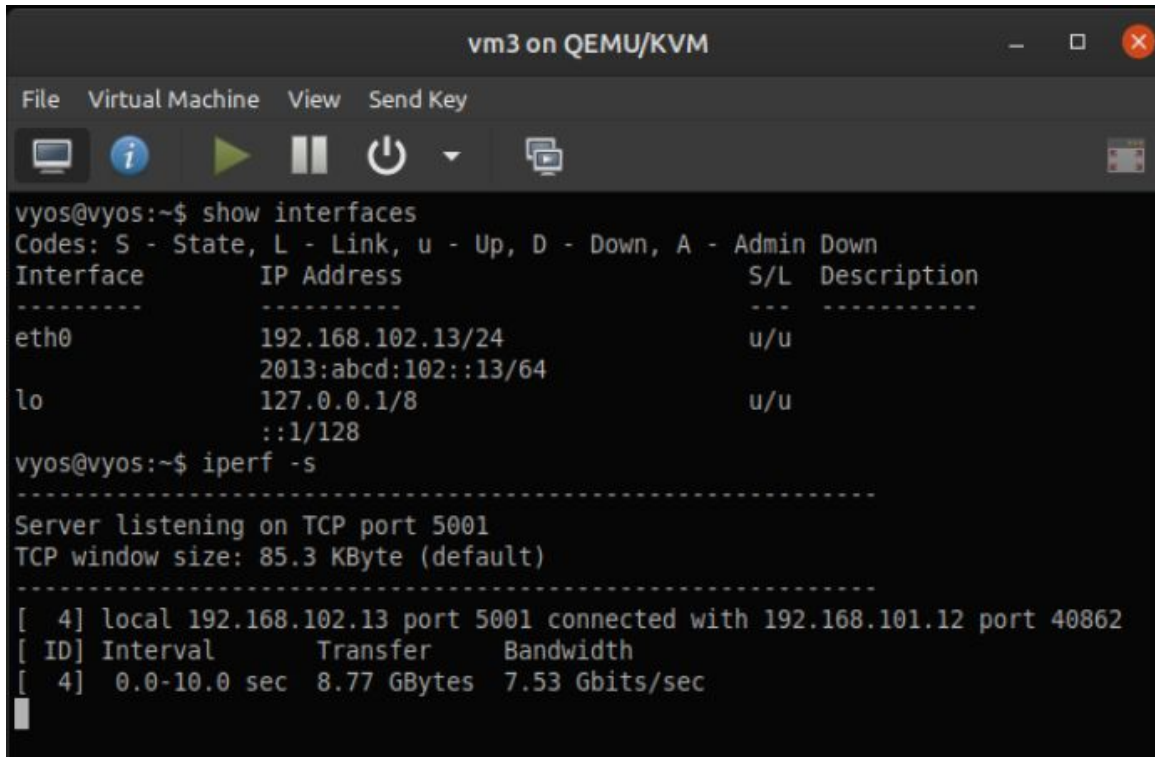
vyos@vyos:~$ show interfaces
Codes: S - State, L - Link, u - Up, D - Down, A - Admin Down
Interface      IP Address      S/L  Description
-----
eth0           192.168.101.12/24  u/u
              2013:abcd:101::12/64
lo             127.0.0.1/8      u/u
              ::1/128
vyos@vyos:~$ iperf -c 192.168.102.13
-----
Client connecting to 192.168.102.13, TCP port 5001
TCP window size: 85.0 KByte (default)
-----
[  3] local 192.168.101.12 port 40862 connected with 192.168.102.13 port 5001
[ ID] Interval      Transfer    Bandwidth
[  3]  0.0-10.0 sec  8.77 GBytes  7.53 Gbits/sec
vyos@vyos:~$
```

VyOS2:

```
vm2 on QEMU/KVM
File Virtual Machine View Send Key
[Icons: Monitor, Info, Play, Pause, Power, Dropdown, Share]

vyos@vyos:~$ show interfaces
Codes: S - State, L - Link, u - Up, D - Down, A - Admin Down
Interface      IP Address      S/L  Description
-----
eth0           192.168.101.10/24  u/u
              2013:abcd:101::10/64
eth1           192.168.102.10/24  u/u
              2013:abcd:102::10/64
lo             127.0.0.1/8      u/u
              ::1/128
vyos@vyos:~$
```

### VyOS3:



```
vm3 on QEMU/KVM
File Virtual Machine View Send Key
[Icons: Monitor, Info, Play, Pause, Power, Dropdown, Copy]

vyos@vyos:~$ show interfaces
Codes: S - State, L - Link, u - Up, D - Down, A - Admin Down
Interface      IP Address      S/L  Description
-----
eth0            192.168.102.13/24  u/u
                2013:abcd:102::13/64
lo              127.0.0.1/8      u/u
                ::1/128
vyos@vyos:~$ iperf -s
-----
Server listening on TCP port 5001
TCP window size: 85.3 KByte (default)
-----
[  4] local 192.168.102.13 port 5001 connected with 192.168.101.12 port 40862
[ ID] Interval      Transfer    Bandwidth
[  4] 0.0-10.0 sec  8.77 GBytes 7.53 Gbits/sec
```

## IPv6:

```
vm1 on QEMU/KVM
File Virtual Machine View Send Key
[Icons: Monitor, Info, Play, Pause, Power, Dropdown, Shared]

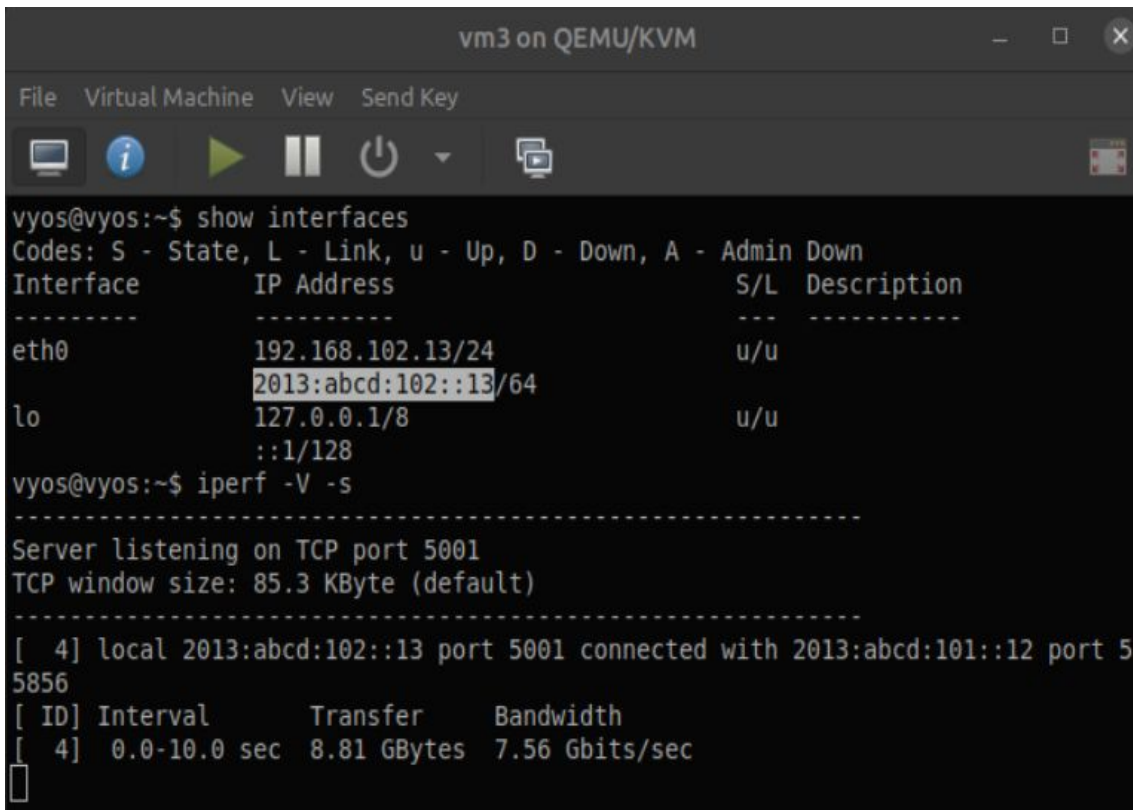
vyos@vyos:~$ show interfaces
Codes: S - State, L - Link, u - Up, D - Down, A - Admin Down
Interface      IP Address      S/L  Description
-----
eth0            192.168.101.12/24  u/u
                2013:abcd:101::12/64
lo              127.0.0.1/8      u/u
                ::1/128
vyos@vyos:~$ iperf -V -c 2013:abcd:102::13
-----
Client connecting to 2013:abcd:102::13, TCP port 5001
TCP window size: 45.0 KByte (default)
-----
[  3] local 2013:abcd:101::12 port 55856 connected with 2013:abcd:102::13
port 5001
[ ID] Interval      Transfer      Bandwidth
[  3]  0.0-10.0 sec  8.81 GBytes  7.57 Gbits/sec
vyos@vyos:~$
```

## VyOS2:

```
vm2 on QEMU/KVM
File Virtual Machine View Send Key
[Icons: Monitor, Info, Play, Pause, Power, Dropdown, Shared]

vyos@vyos:~$ show interfaces
Codes: S - State, L - Link, u - Up, D - Down, A - Admin Down
Interface      IP Address      S/L  Description
-----
eth0            192.168.101.10/24  u/u
                2013:abcd:101::10/64
eth1            192.168.102.10/24  u/u
                2013:abcd:102::10/64
lo              127.0.0.1/8      u/u
                ::1/128
vyos@vyos:~$
```

### VyOS3:



```
vm3 on QEMU/KVM
File Virtual Machine View Send Key
[Icons: Monitor, Info, Play, Pause, Power, Copy]

vyos@vyos:~$ show interfaces
Codes: S - State, L - Link, u - Up, D - Down, A - Admin Down
Interface      IP Address      S/L  Description
-----
eth0            192.168.102.13/24  u/u
                2013:abcd:102::13/64
lo              127.0.0.1/8      u/u
                ::1/128
vyos@vyos:~$ iperf -V -s
-----
Server listening on TCP port 5001
TCP window size: 85.3 KByte (default)
-----
[ 4] local 2013:abcd:102::13 port 5001 connected with 2013:abcd:101::12 port 5
5856
[ ID] Interval      Transfer      Bandwidth
[ 4]  0.0-10.0 sec  8.81 GBytes  7.56 Gbits/sec
█
```

- b) Compare the results between Question 4, and describe your thoughts (OPTIONAL: and appropriate reference or justification).

TCP throughput in Q4 ~ 18.8 Gbits/sec

TCP throughput in Q5 ~ 7.5 Gbits/sec

We observed a significant drop in the TCP throughput because of increase in the no. of hops (i.e no. of hops increased to two).