CS3543 Lab Assignment for Jan 18th

(Deadline: 23:59 on January 22rd (WED), 2019)

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General Information

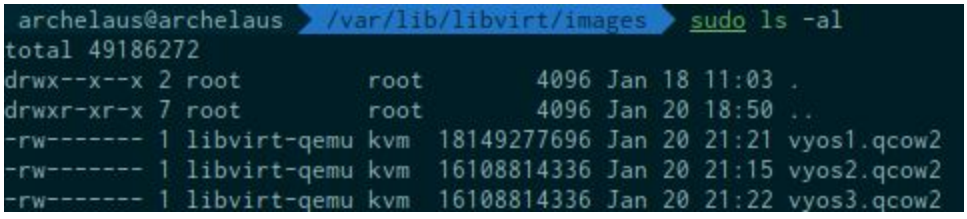
1. This assignment can be conducted and submitted by a per (up to 2) of students. The same mark will be offered to the pair of students regardless of individual contributions.
2. The assignment is customized for Ubuntu + KVM environment. It is highly recommended for non-Ubuntu users to enable dual boot 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 locally 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.

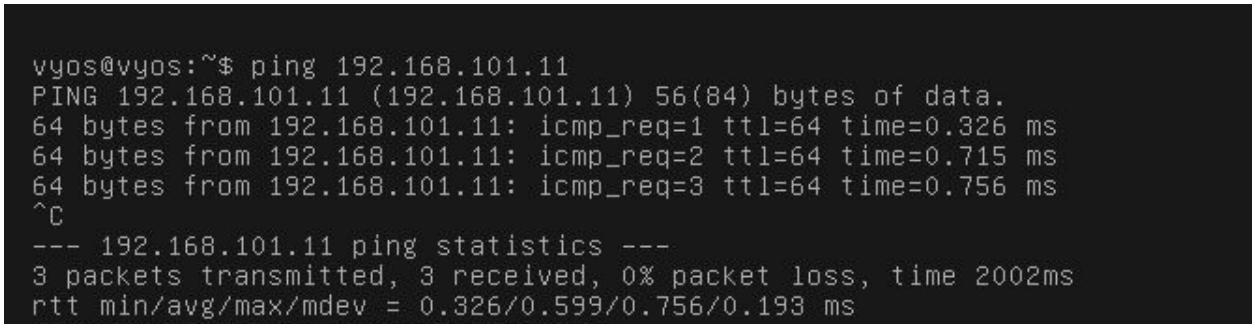
	VyOS1	VyOS2	VyOS3
IPv4 Address and Subnet Mask given to eth0	192.168.101.10/24	192.168.101.11/24	192.168.102.12/24
IPv6 Address and Subnet Mask given to eth0	2013:abcd:101::10/64	2013:abcd:101::11/64	2013:abcd:102::12/64

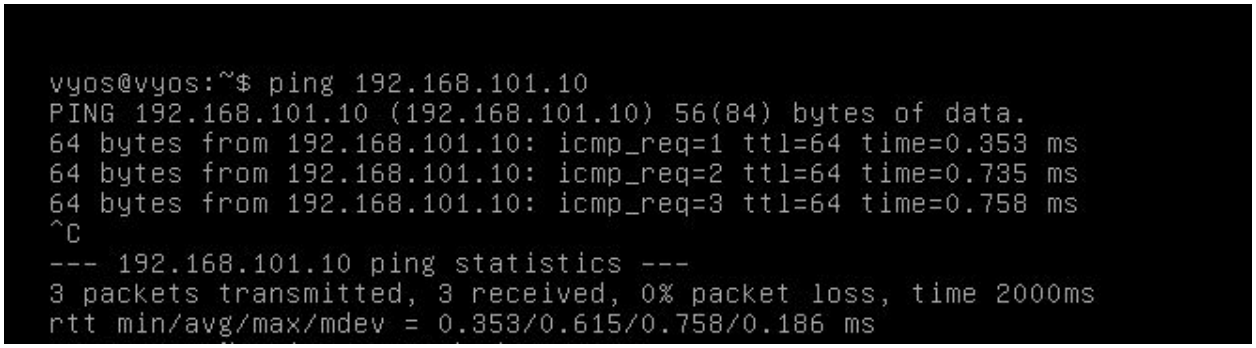
MAC Address of eth0	52:54:00:a4:7b:2f	52:54:00:6f:28:22	52:54:00:49:5d:52
Bridge I/F selected for connecting eth0	bri0: 02:a5:cc:8c:6a:48	bri0: 02:a5:cc:8c:6a:48	bri1: 8a:ab:f9:c9:c9:94
IPv4 Address and Subnet Mask given to eth1	N/A	192.168.102.11/24	N/A
IPv6 Address and Subnet Mask given to eth1	N/A	2013:abcd:102::11/64	N/A
MAC Address of eth1	N/A	52:54:00:68:d4:8b	N/A
Bridge I/F selected for connecting eth1	N/A	bri1: 8a:ab:f9:c9:c9:94	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.



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.





```
vyos@vyos:~$ ping6 2013:abcd:101::11
PING 2013:abcd:101::11(2013:abcd:101::11) 56 data bytes
64 bytes from 2013:abcd:101::11: icmp_seq=1 ttl=64 time=0.811 ms
64 bytes from 2013:abcd:101::11: icmp_seq=2 ttl=64 time=0.822 ms
64 bytes from 2013:abcd:101::11: icmp_seq=3 ttl=64 time=0.840 ms
^C
--- 2013:abcd:101::11 ping statistics ---
3 packets transmitted, 3 received, 0% packet loss, time 2003ms
rtt min/avg/max/mdev = 0.811/0.824/0.840/0.026 ms
vyos@vyos:~$ _
```

```
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=0.798 ms
64 bytes from 2013:abcd:101::10: icmp_seq=2 ttl=64 time=0.657 ms
64 bytes from 2013:abcd:101::10: icmp_seq=3 ttl=64 time=0.819 ms
^C
--- 2013:abcd:101::10 ping statistics ---
3 packets transmitted, 3 received, 0% packet loss, time 2003ms
rtt min/avg/max/mdev = 0.657/0.758/0.819/0.071 ms
vyos@vyos:~$ _
```

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

```
vyos@vyos:~$ iperf -s -i 1
------------------------------------------------------------
Server listening on TCP port 5001
TCP window size: 85.3 KByte (default)
------------------------------------------------------------
[  4] local 192.168.101.11 port 5001 connected with 192.168.101.10 port 56842
[ ID] Interval       Transfer     Bandwidth
[  4]  0.0- 1.0 sec  0.00 Bytes  0.00 bits/sec
[  4]  0.0- 1.0 sec  2.10 GBytes  18.0 Gbits/sec
^Cvyos@vyos:~$ _
```

```
vyos@vyos:~$ iperf -c 192.168.101.11 -t 1
------------------------------------------------------------
Client connecting to 192.168.101.11, TCP port 5001
TCP window size: 85.0 KByte (default)
------------------------------------------------------------
[  3] local 192.168.101.10 port 56842 connected with 192.168.101.11 port 5001
[ ID] Interval       Transfer     Bandwidth
[  3]  0.0- 1.0 sec  2.10 GBytes  18.0 Gbits/sec
vyos@vyos:~$
```

ipv6

```
vyos@vyos:~$ iperf -V -s -i 1
------------------------------------------------------------
Server listening on TCP port 5001
TCP window size: 85.3 KByte (default)
------------------------------------------------------------
[  4] local 2013:abcd:101::11 port 5001 connected with 2013:abcd:101::10 port 38
965
[ ID] Interval       Transfer     Bandwidth
[  4]  0.0- 1.0 sec  0.00 Bytes  0.00 bits/sec
[  4]  0.0- 1.0 sec  1.99 GBytes  17.1 Gbits/sec
^Cvyos@vyos:~$ _
```

```
vyos@vyos:~$ iperf -V -c 2013:abcd:101::11 -t 1
------------------------------------------------------------
Client connecting to 2013:abcd:101::11, TCP port 5001
TCP window size: 45.0 KByte (default)
------------------------------------------------------------
[  3] local 2013:abcd:101::10 port 38965 connected with 2013:abcd:101::11 port 5
001
[ ID] Interval       Transfer     Bandwidth
[  3]  0.0- 1.0 sec  1.99 GBytes  17.1 Gbits/sec
vyos@vyos:~$ _
```

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

```
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 192.168.101.11, eth0
vyos@vyos:~$ _
```

vyos2

```
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
C>* 192.168.102.0/24 is directly connected, eth1
vyos@vyos:~$
```

vyos3

```
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 192.168.102.11, eth0
C>* 192.168.102.0/24 is directly connected, eth0
vyos@vyos:~$ _
```

Question 5.3.

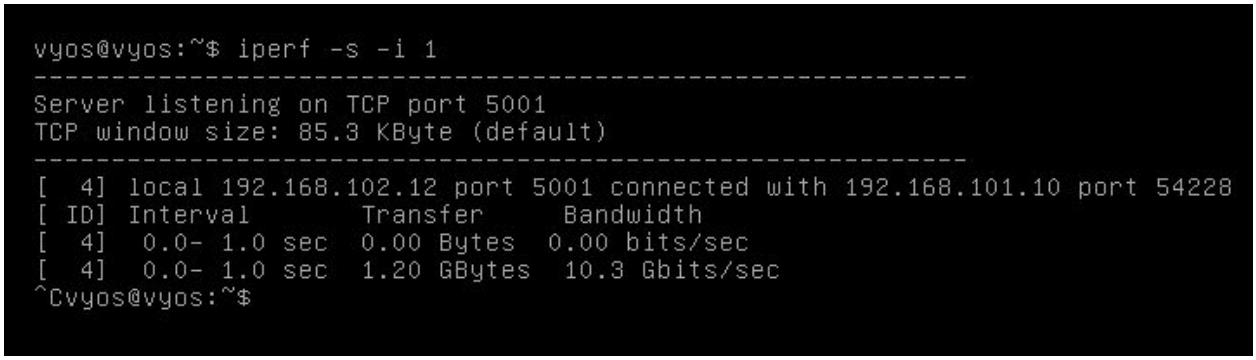
Show that both ping and ping6 are successful between VyOS1 and VyOS3. You may answer by pasting the screen capture of the result of both commands.

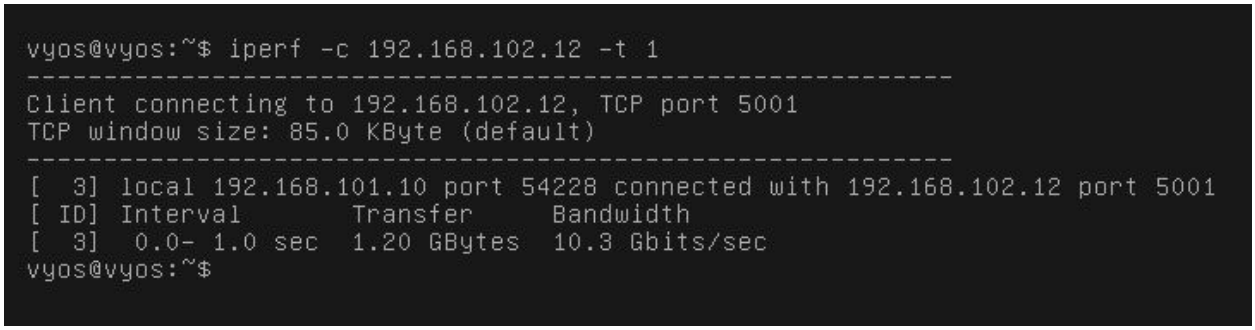
```
vyos@vyos:~$ ping 192.168.102.12
PING 192.168.102.12 (192.168.102.12) 56(84) bytes of data.
64 bytes from 192.168.102.12: icmp_req=1 ttl=63 time=0.793 ms
64 bytes from 192.168.102.12: icmp_req=2 ttl=63 time=1.42 ms
64 bytes from 192.168.102.12: icmp_req=3 ttl=63 time=1.49 ms
^C
--- 192.168.102.12 ping statistics ---
3 packets transmitted, 3 received, 0% packet loss, time 2002ms
rtt min/avg/max/mdev = 0.793/1.234/1.491/0.316 ms
vyos@vyos:~$ ping6 2013:abcd:102::12
PING 2013:abcd:102::12(2013:abcd:102::12) 56 data bytes
64 bytes from 2013:abcd:102::12: icmp_seq=1 ttl=63 time=0.689 ms
64 bytes from 2013:abcd:102::12: icmp_seq=2 ttl=63 time=1.39 ms
64 bytes from 2013:abcd:102::12: icmp_seq=3 ttl=63 time=1.84 ms
^C
--- 2013:abcd:102::12 ping statistics ---
3 packets transmitted, 3 received, 0% packet loss, time 2002ms
rtt min/avg/max/mdev = 0.689/1.309/1.846/0.476 ms
vyos@vyos:~$ _
```

```
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=63 time=0.709 ms
64 bytes from 192.168.101.10: icmp_req=2 ttl=63 time=1.56 ms
64 bytes from 192.168.101.10: icmp_req=3 ttl=63 time=1.34 ms
^C
--- 192.168.101.10 ping statistics ---
3 packets transmitted, 3 received, 0% packet loss, time 2002ms
rtt min/avg/max/mdev = 0.709/1.208/1.567/0.365 ms
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=63 time=0.596 ms
64 bytes from 2013:abcd:101::10: icmp_seq=2 ttl=63 time=1.29 ms
64 bytes from 2013:abcd:101::10: icmp_seq=3 ttl=63 time=1.36 ms
^C
--- 2013:abcd:101::10 ping statistics ---
3 packets transmitted, 3 received, 0% packet loss, time 2001ms
rtt min/avg/max/mdev = 0.596/1.085/1.361/0.347 ms
vyos@vyos:~$ _
```

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.





```
vyos@vyos:~$ iperf -V -s -i 1
------------------------------------------------------------
Server listening on TCP port 5001
TCP window size: 85.3 KByte (default)
------------------------------------------------------------
[  4] local 2013:abcd:102::12 port 5001 connected with 2013:abcd:101::10 port 43
455
[ ID] Interval       Transfer     Bandwidth
[  4]  0.0- 1.0 sec  0.00 Bytes  0.00 bits/sec
[  4]  0.0- 1.0 sec  1.05 GBytes  9.01 Gbits/sec
^Cvyos@vyos:~$
```

```
vyos@vyos:~$ iperf -V -c 2013:abcd:102::12 -t 1
------------------------------------------------------------
Client connecting to 2013:abcd:102::12, TCP port 5001
TCP window size: 45.0 KByte (default)
------------------------------------------------------------
[  3] local 2013:abcd:101::10 port 43455 connected with 2013:abcd:102::12 port 5
001
[ ID] Interval       Transfer     Bandwidth
[  3]  0.0- 1.0 sec  1.05 GBytes  9.03 Gbits/sec
vyos@vyos:~$
```

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

The default TCP port for iperf is 5001.
The default TCP window size for ipv6(client) is around half that of ipv4(client), this might show that the latency between source and destination in ipv6 is lesser.
The Transfer column represents the throughput.
ipv4:

> We notice that the value in Question 5.4.a is around half that of Question 2. This is because the traffic is to be redirected from vyos2 to respective vyos host. Due to this hop, there exists a latency and hence, the throughput in affected(reduced).

ipv6: This also follows the same case as the above.
The bandwidth column represents rate of speed with which the data is transferred.

For both ipv4 and ipv6, the Rate is almost half in Question 5.4.a of Question 4.

Also, when due to hop in between, there is a chance that packet is lost which reduces the throughput. It might also be due to queuing, channel access, propagation and transmission delays.

Done!!