CS3611 Computer Networks (Spring 2023)
Lab 1: Environment and Softwares

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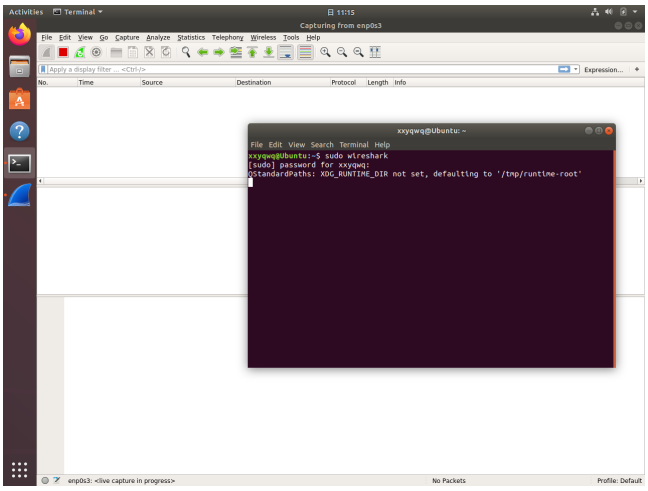
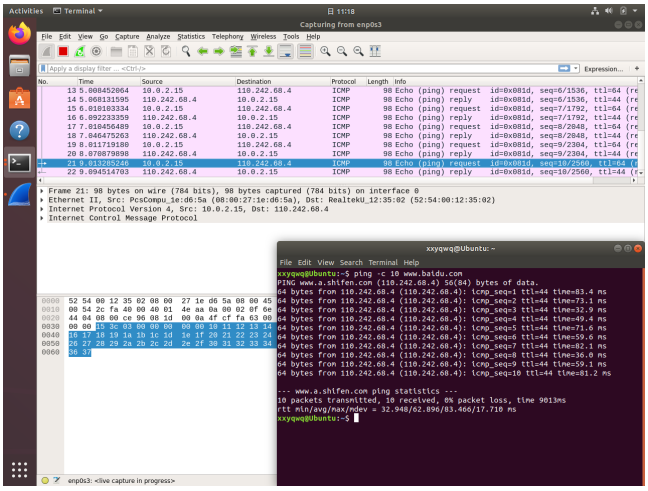
1. Run wireshark as a root user.

```
$ sudo wireshark
```



Ping “www.baidu.com” 10 times.

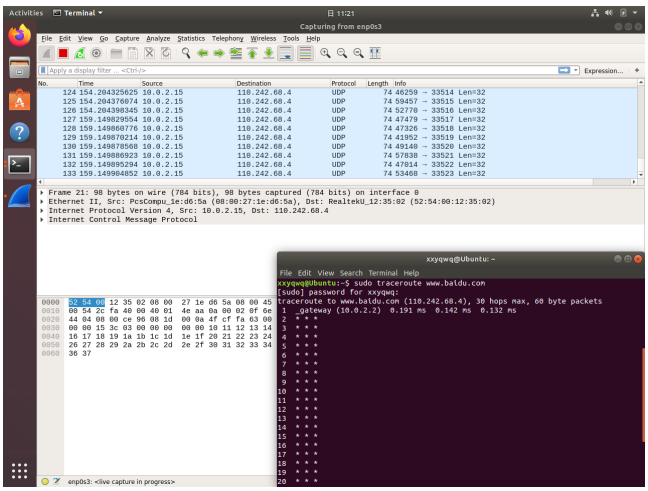
```
$ ping -c 10 www.baidu.com
```



We can conclude that “ping” uses ICMP protocol.

Traceroute “www.baidu.com” as a root user.

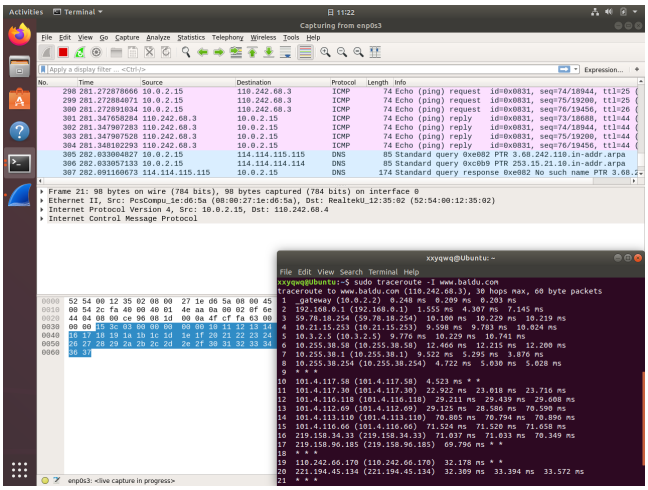
```
$ sudo traceroute www.baidu.com
```



Note that addresses are hidden for timeout. This is because "traceroute" uses UDP protocol by default.

Specify ICMP protocol for "traceroute".

```
$ sudo traceroute -I www.baidu.com
```

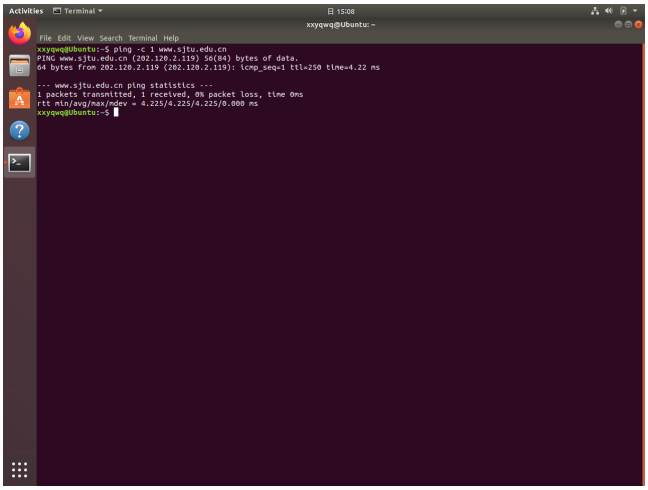


Now "traceroute" uses ICMP protocol and returns complete results.

2. Ping "www.sjtu.edu.cn" only once.

```
$ ping -c 1 www.sjtu.edu.cn
PING www.sjtu.edu.cn (202.120.2.119) 56(84) bytes of data.
64 bytes from 202.120.2.119 (202.120.2.119): icmp_seq=1 ttl=250 time
    =4.22 ms

--- www.sjtu.edu.cn ping statistics ---
1 packets transmitted, 1 received, 0% packet loss, time 0ms
```

```
rtt min/avg/max/mdev = 4.225/4.225/4.225/0.000 ms
```



Therefore, the IP address of "www.sjtu.edu.cn" is "202.120.2.119".

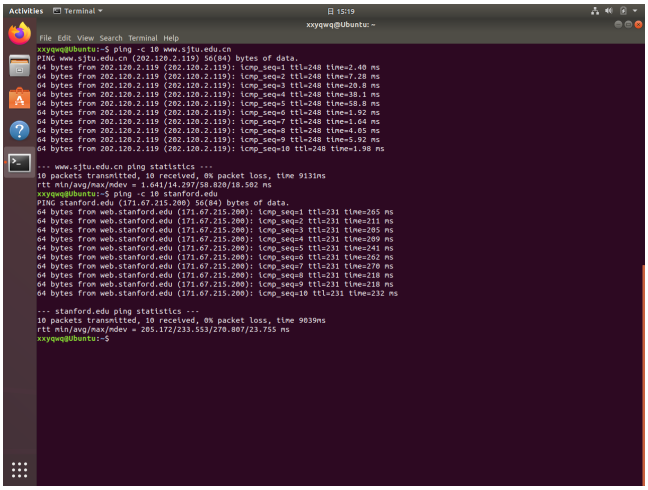
3. Ping "www.sjtu.edu.cn" 10 times.

```
$ ping -c 10 www.sjtu.edu.cn
PING www.sjtu.edu.cn (202.120.2.119) 56(84) bytes of data.
64 bytes from 202.120.2.119 (202.120.2.119): icmp_seq=1 ttl=248 time
    =2.40 ms
64 bytes from 202.120.2.119 (202.120.2.119): icmp_seq=2 ttl=248 time
    =7.28 ms
64 bytes from 202.120.2.119 (202.120.2.119): icmp_seq=3 ttl=248 time
    =20.8 ms
64 bytes from 202.120.2.119 (202.120.2.119): icmp_seq=4 ttl=248 time
    =38.1 ms
64 bytes from 202.120.2.119 (202.120.2.119): icmp_seq=5 ttl=248 time
    =58.8 ms
64 bytes from 202.120.2.119 (202.120.2.119): icmp_seq=6 ttl=248 time
    =1.92 ms
64 bytes from 202.120.2.119 (202.120.2.119): icmp_seq=7 ttl=248 time
    =1.64 ms
64 bytes from 202.120.2.119 (202.120.2.119): icmp_seq=8 ttl=248 time
    =4.05 ms
64 bytes from 202.120.2.119 (202.120.2.119): icmp_seq=9 ttl=248 time
    =5.92 ms
64 bytes from 202.120.2.119 (202.120.2.119): icmp_seq=10 ttl=248 time
    =1.98 ms

--- www.sjtu.edu.cn ping statistics ---
10 packets transmitted, 10 received, 0% packet loss, time 9131ms
```

```
rtt min/avg/max/mdev = 1.641/14.297/58.820/18.502 ms
```

Ping “stanford.edu” 10 times.

```
$ ping -c 10 stanford.edu
PING stanford.edu (171.67.215.200) 56(84) bytes of data.
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=1 ttl=231
    time=265 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=2 ttl=231
    time=211 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=3 ttl=231
    time=205 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=4 ttl=231
    time=209 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=5 ttl=231
    time=241 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=6 ttl=231
    time=262 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=7 ttl=231
    time=270 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=8 ttl=231
    time=218 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=9 ttl=231
    time=218 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=10 ttl=231
    time=232 ms

--- stanford.edu ping statistics ---
10 packets transmitted, 10 received, 0% packet loss, time 9039ms
rtt min/avg/max/mdev = 205.172/233.553/270.807/23.755 ms
```



Therefore, the average round trip time is 14.297ms to "www.sjtu.edu.cn" and 233.553ms to "stanford.edu".

To analyze the reason for RTT difference, we can assume "www.sjtu.edu.cn" and "stanford.edu" have similar server load and network quality. Then the major RTT of "stanford.edu" should come from transmission for its longer geographic distance. Since "www.sjtu.edu.cn" is physically closer to my location than "stanford.edu", it is likely to have a lower RTT. In addition, the round trip to "stanford.edu" goes through more ISPs, which can bring more latency.

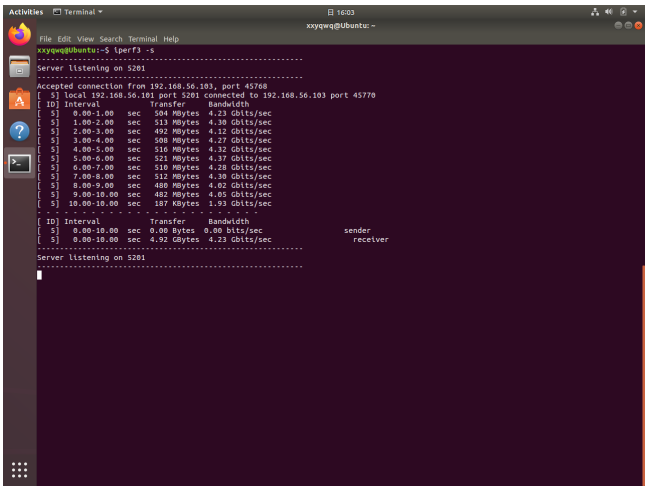
4. Start iperf3 on server.

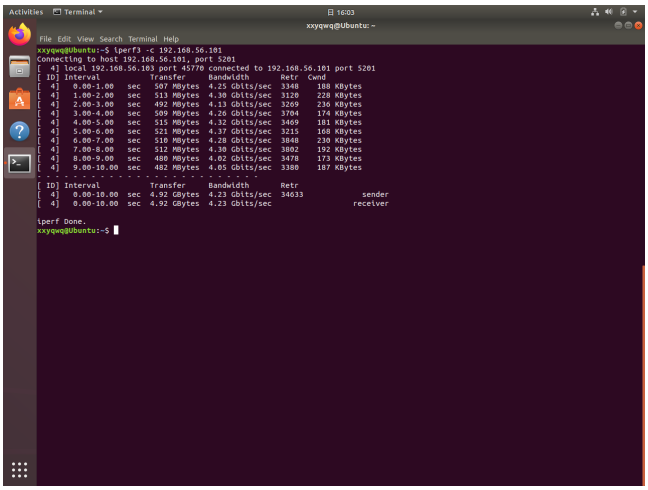
```
$ iperf3 -s
-----------------------------------------------------------
Server listening on 5201
-----------------------------------------------------------
```

Run iperf3 on client.

```
$ iperf3 -c 192.168.56.101
Connecting to host 192.168.56.101, port 5201
[  4] local 192.168.56.103 port 45770 connected to 192.168.56.101 port
    5201
[ ID] Interval           Transfer     Bandwidth       Retr  Cwnd
[  4]   0.00-1.00   sec   507 MBytes  4.25 Gbits/sec  3348    188
   KBytes
[  4]   1.00-2.00   sec   513 MBytes  4.30 Gbits/sec  3120    228
   KBytes
[  4]   2.00-3.00   sec   492 MBytes  4.13 Gbits/sec  3269    236
   KBytes
[  4]   3.00-4.00   sec   509 MBytes  4.26 Gbits/sec  3704    174
   KBytes
[  4]   4.00-5.00   sec   515 MBytes  4.32 Gbits/sec  3469    181
   KBytes
[  4]   5.00-6.00   sec   521 MBytes  4.37 Gbits/sec  3215    168
   KBytes
[  4]   6.00-7.00   sec   510 MBytes  4.28 Gbits/sec  3848    230
   KBytes
[  4]   7.00-8.00   sec   512 MBytes  4.30 Gbits/sec  3802    192
   KBytes
[  4]   8.00-9.00   sec   480 MBytes  4.02 Gbits/sec  3478    173
   KBytes
[  4]   9.00-10.00  sec   482 MBytes  4.05 Gbits/sec  3380    187
   KBytes
- - - - - - - - - - - - - - - - - - - - - - - - -
```

```
[ ID] Interval           Transfer     Bandwidth       Retr
[  4]   0.00-10.00  sec  4.92 GBytes  4.23 Gbits/sec  34633
      sender
[  4]   0.00-10.00  sec  4.92 GBytes  4.23 Gbits/sec
    receiver

iperf Done.
```





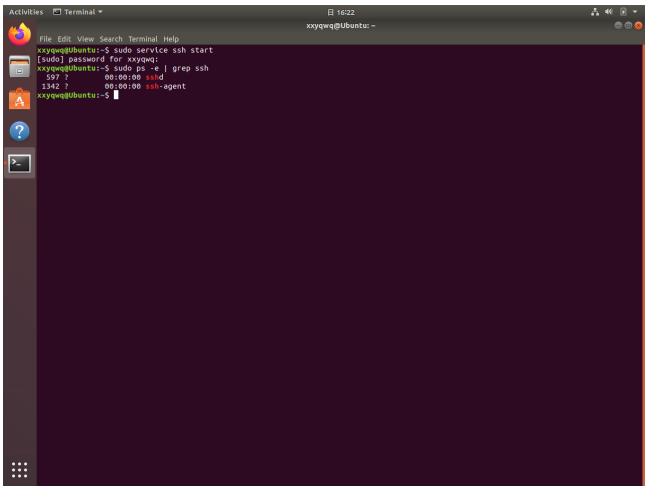
Therefore, the TCP bandwidth between two virtual machines is 4.23Gbits/sec.

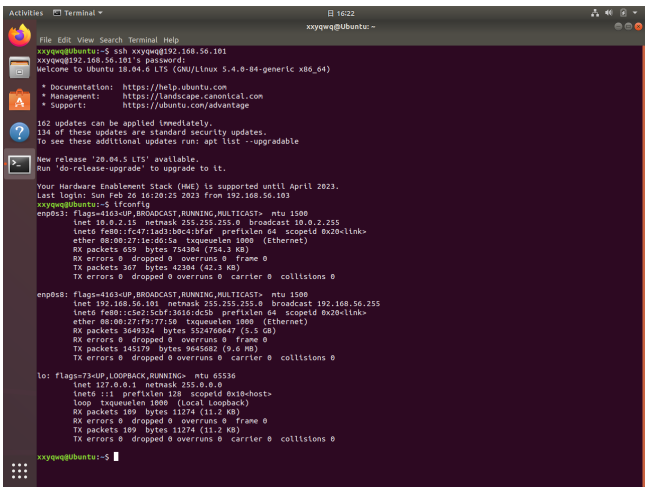
5. Start ssh on server.

```
$ sudo service ssh start
$ sudo ps -e | grep ssh
  597 ?        00:00:00 sshd
 1342 ?        00:00:00 ssh-agent
```

Run ssh on client.

```
$ ssh xxyqwq@192.168.56.101
xxyqwq@192.168.56.101's password:
Welcome to Ubuntu 18.04.6 LTS (GNU/Linux 5.4.0-84-generic x86_64)

Last login: Sun Feb 26 16:20:25 2023 from 192.168.56.103
```





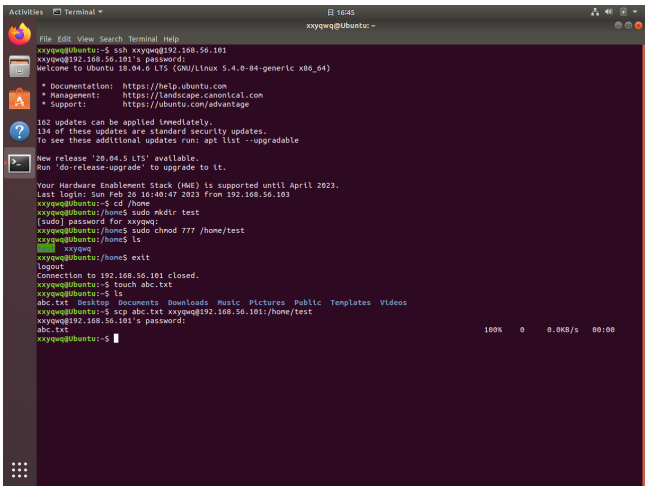
6. Create folder "/home/test" on server.

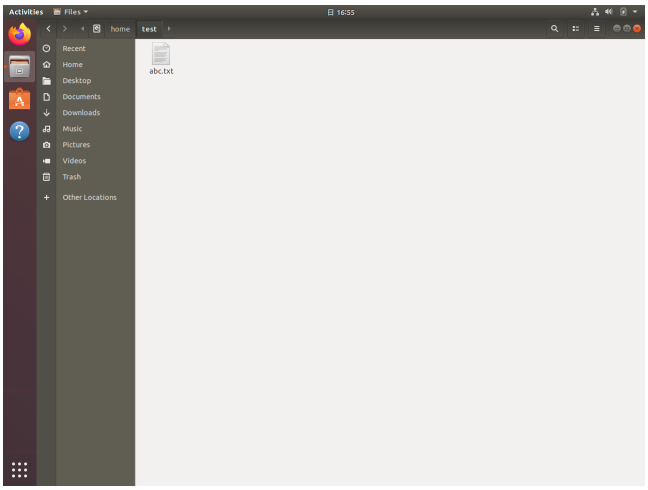
```
$ ssh xxyqwq@192.168.56.101
$ cd /home
$ sudo mkdir test
$ sudo chmod 777 /home/test
$ ls
test  xxyqwq
$ exit
```

Create file "abc.txt" and upload it to server.

```
$ touch abc.txt
```

```
$ ls
abc.txt  Desktop  Documents  Downloads  Music  Pictures  Public
    Templates  Videos
$ scp abc.txt xxyqwq@192.168.56.101:/home/test
xxyqwq@192.168.56.101's password:
abc.txt
                                    100%    0      0.0KB/s   00:00
```





We can see that “abc.txt” has been copied to “/home/test” on server.